SOIL SALINITY ABATEMENT FOLLOWING HURRICANE IKE

A Thesis

by

RYAN MATTHEW MUELLER

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

August 2012

Major Subject: Soil Science

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Approved by:

Chair of Committee,	Charles Thomas Hallmark
Committee Members,	Mort Kothmann
	Sam Feagley
Head of Department,	David D. Baltensperger

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ABSTRACT

Soil Salinity Abatement Following Hurricane Ike. (August 2012)

Ryan Matthew Mueller, B.S., Texas A&M University

Chair of Advisory Committee: Dr. Charles Thomas Hallmark

In September 2008 Hurricane Ike hit the Texas Gulf Coast with a force stronger than the category 2 storm at which it was rated. With a 3.8 m (12.5 ft) storm surge, the agricultural industry in the area was devastated. The goal of this research was to determine the length of time required to reduce the salt levels brought by the storm surge to near pre-hurricane levels. To do this, four sets of samples were taken across two years and analyzed for salinity using the saturated paste extract method.

The initial salt levels in November 2008 had an electrical conductivity (EC_e) of the inundated soils as high as 26.7 dS/m. Fifty-four percent of the soils sampled in the 0-15 cm horizons and 9% in the 15-30 cm horizons of the edge area had an $EC_e \geq 4$ dS/m. In the surge area 79% of the soils sampled in the 0-15 cm horizons and 30% in the 15-30 cm horizons had an $EC_e \geq 4$ dS/m.

In April 2009, 38% of the soils sampled in the 0-15 cm horizons and 13% in the 15-30 cm horizons of the edge area had an $EC_e \geq 4$ dS/m. In the surge area 71% of the soils sampled in the 0-15 cm horizons and 39% in the 15-30 cm horizons had an $EC_e \geq 4$ dS/m.

By December 2009, none of the soils sampled in the edge area had an $EC_e \geq 4$ dS/m. In the surge area 21% of the soils sampled in the 0-15 cm horizons and 33% in the 15-30 cm horizons had an $EC_e \geq 4$ dS/m. By October 2010, all soils sampled had leached sufficient salts to be classified as non-saline to very slightly saline soils.

Utilizing the November 2008 data set, 28 random samples were selected for exchangeable Na percent (ESP) in order to develop the ESP-SAR (Na adsorption ratio) predictive equation, $ESP= 1.19(SAR)^{0.82}$. The SAR-ESP relationship is statistically significant (95% confidence level), with a correlation coefficient of 0.964 (df=26).

DEDICATION

To my parents and grandparents who encouraged me to return to school and pursue my graduate degree. Their love and support have helped me throughout my life, through my undergraduate college career, and especially throughout my graduate school career.

Also, to my wife, Melissa, who has stood beside me throughout my graduate school career. Her patience and understanding have been extremely gracious.

ACKNOWLEDGEMENTS

I would like to thank my committee chair, Dr. Hallmark, and my committee members, Dr. Kothmann, and Dr. Feagley for their guidance and support throughout the course of this research.

I would also like to thank Donna Prochaska, for analyzing the soil samples along with showing me how to perform the tests in the Texas AgriLife Research Soil Characterization Laboratory.

Thank you to the Natural Resources Conservation Service (NRCS) for funding for this project as well as being an active part of this research. Thanks go especially to the NRCS employees that helped obtain soil samples used in this study: Kenny Hall, Stacey Kloesel, and Jon Weidenfeld.

Finally, thanks to my mother, father, and wife for their encouragement, love, and support.

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1. INTRODUCTION

Three major hurricanes (Katrina, Rita, Ike) disrupted the Gulf Coast since 2005 and prompted interest in determining the effects of sea water inundation on soils. On September 13, 2008 Hurricane Ike made landfall on the Texas Gulf Coast as a Category 2 storm, with an unusually large storm surge of 3.8 m (12.5 feet) inundating approximately 202,000 ha (500,000 acres) in Chambers, Jefferson, and Orange Counties (Brooks, 2009). Landowners, managers, and agency responders questioned the length of time for soils to rebound from the intrusion of salt water, and a literature search showed the subject had not been addressed. Therefore, this study was undertaken cooperatively with the Natural Resources Conservation Service (NRCS) to evaluate the initial salt loading in the surge area and track the salt levels over time as salts were removed from the soils by rainfall events.

Researchers and practitioners have proven that there has to be a balance between adequate leaching of salt and drainage to maintain irrigated agricultural production (Tanji, 1990). Salts that are common to soils, surface water, groundwater, and seawater are a combination of sodium, calcium, potassium, magnesium, chlorides, nitrates, sulfates, bicarbonates and carbonates (Provin and Pitt, 2004). Soil salinity is a major factor that influences plant growth. Salt tolerance is growth-stage dependent, and generally, the younger a plant, the more susceptible it is to higher concentrations of salts

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This thesis follows the style of the Soil Science Society of America Journal.

(El-Swaify, 2000). Salinity limits plant growth by decreasing the osmotic potential (increasing the osmotic tension) making it more difficult for a plant to extract water from the soil.

The affected area of the Hurricane Ike storm surge consisted of state and national wildlife refuges, rice fields, pasturelands, rangelands, and hay meadows (Brooks, 2009). The vegetation of all these lands could be expected to respond negatively to salinity, and rice serves as an example. Rice, which has a moderately sensitive salt tolerance, has a 25% decrease in yield at a soil salinity level of 5 dS/m (El-Swaify, 2000), and its vegetative growth in saline soils is typically patchy. Following storm surge inundation, most of the salt would be contained in the surface horizons rather than in the subsoil horizons (McLeod et al., 2009; Slavich et al., 2006). The level of salinity in soils affected by the storm surge varied widely and plant growth in the inundated area followed this trend.

Soil salinity can be determined by measuring the soil's electrical conductivity (EC) through the use of saturated paste extracts. The saturated paste extract method can be used with all levels of saline soils, and can be used with various soil textures, since it relates more to the natural response of plants to moisture and salt stress (McLeod et al., 2009; Richards, 1954).

The objectives of this study were: (i) to determine the amount of salt delivered by the storm surge in Chambers, Jefferson, and Orange Counties, (ii) to track salt and exchangeable Na levels over time, and (iii) to determine when salinity and sodicity levels would return to non-saline, non-sodic levels.

2. REVIEW OF LITERATURE

Salinity affects plant establishment, health, yield, and rejuvenation. Visually, soil salinity alters the appearance of plants through unusual growth patterns or reduced vigor (Slavich et al., 2006). Productivity of crops and pasture plants generally decreases as salinity increases (Tanji, 1990). Successful plant growth in the counties affected by Hurricane Ike relies on the salt tolerance of the plant.

2.1 General Nature of Salts

The four primary cations that compose soluble salts are Na^+, K^+, Ca^{2+}, and Mg^{2+} , with the major anions consisting of Cl^-, SO_4^{2-}, HCO_3^-, NO_3^-, and in a strongly alkaline soil, CO_3^{2-} (Tanji, 1990). Most salts are naturally occurring and are found in irrigation water and fertilizers (Kotuby-Amacher et al., 2000; Thompson and Walworth, 2006), as well as seawater and fossil salts from parent materials.

Salt can remain in the soil anywhere from a few hours to years depending on the initial salt load and amount of post surge precipitation (McLeod et al., 2009). Larger pores in sandy soils allow for quicker leaching (Thompson and Walworth, 2006). When salts fail to dissolve and leach below the root zone, salt problems result (Provin and Pitt, 2004). Soil salt content determines whether or not the soil is considered non-saline or saline (El-Swaify, 2000), and three widely accepted classes of salt-affected soils exist: saline-non sodic, saline-sodic, and non-saline-sodic (Provin and Pitt, 2004).

Some salts are essential plant nutrients. Plants control water uptake into roots by adjusting their cell osmotic potential with soluble salts and organic molecules. As salinity decreases the osmotic potential of soil solutions, it becomes more difficult for plants to extract water from the soil. In extreme cases when soil salts become sufficiently great, water is extracted from the roots of plants.

When plants are exposed to a high level of salt for an extended time, stunted growth and plant death can result (Bernstein, 1975; Blaylock, 1994; El-Swaify, 2000; Thompson and Walworth, 2006). Ions such as Na^+, Cl^-, and B (H_3BO_4) are toxic to plants (Blaylock, 1994). Chlorides cause plants to become increasingly succulent, as leaves become thicker and darker than normal and with some species, leaves appear blue-green. Leaf-burn, leaf-tip burn, and bronzing of leaves are other symptoms of a salt-affected plant (Bernstein, 1975; Richards, 1954).

Plant response to salinity is evaluated by three criteria: (i) the salinity level (range) where the plant is not affected, (ii) the linear decline of the plant to increased salinity, and (iii) the level of salinity where the plant stops growing (El-Swaify, 2000; Richards, 1954). Plant salt tolerance is also affected by climate, soil conditions, cultural practices, and variety (Blaylock, 1994; Provin and Pitt, 2004). Salt injury during cool weather months when plant transpiration is low is less likely than during warmer months (Blaylock, 1994). Soils near the coastline may accumulate salts. Further, plant salt tolerance may be affected by salt spray from the sea (Provin and Pitt, 2004).

Blaylock (1994) describes four classes of salt tolerances of plants: sensitive, moderately sensitive, moderately tolerant, and tolerant. Sensitive plants, such as beans and carrots, are not readily able to adjust to increased salt concentrations making the plant susceptible to injury, while salt tolerant plants such as cotton and Bermudagrass can adjust to the increased salt concentrations in the soil allowing the plant to absorb water more easily (Blaylock, 1994). Moderately sensitive (corn) and moderately tolerant (rice and ryegrass) species are median salt classes between salt sensitive and salt tolerant. Ornamentals, fruits, and vegetables are generally more salt sensitive than their field crop and forage plant counterparts. Plants are usually more susceptible to salt during the seedling stage and germination, right after being transplanted, and when exposed to other stresses (Kotuby-Amacher et al., 2000). Vegetation closest to the shore is made up primarily of salt-tolerant marshes with sandier soil, which the storm surge quickly drains from, with no apparent long term effects. Further inland, the vegetation primarily consists of plants with low to moderate salt tolerance (Federal Emergency Management Agency, 2008).

Common methods used in determining salt concentrations of the soil exist for both field and the laboratory. In performing field tests, an electromagnetic induction (EM) meter is used to determine the apparent EC of soils, soil sodicity, as well as performing many other tests that might be useful to the scientist (McLeod et al., 2009). In the laboratory, most methods involve addition of water and measurement of salt content by electrical conductivity. These include 1:1 soil to water extracts (Zhang et al., 2005), the 1:5 extract analysis (McLeod et al., 2009), and the saturated paste extract method (Richards, 1954).

The saturated paste extract is used widely as it relates to key moisture levels of the soil. Results from the saturated paste extract are considered to be the most accurate and reliable in relating plant and soil responses to salinity as this technique attempts to recreate the conditions of the natural environment (Richards, 1954; Zhang et al., 2005). The process of obtaining a saturated paste extract involves saturating a soil with distilled water until the soil-water mixture begins to flow, allowing time for salts to dissolve, then extraction of solution by vacuum filtration. Electrical conductivity of the extract (EC_e) is measured and generally reported in units of dS/m. Atomic absorption or inductively coupled plasma spectroscopy (ICP) is commonly used to determine the soluble bases: Na, Ca, Mg, and K.

Plant nutrient deficiencies occur when exchangeable Ca and Mg levels drop due to an increase in exchangeable Na (Bernstein, 1975). Increasing Na on soil colloids in the absence of excess salts causes soil particles to disperse and develop poor drainage and structure. Usually pH of the soil will become strongly alkaline, often above 8.5. Most plants are not affected by Na levels until an ESP above 25% is reached; however, some such as beans are affected at an ESP level of 10% (Bernstein, 1975).

By definition, sodic soils have at least 15% exchangeable Na percentage (ESP). However, often sodic soils can be identified by a lack of plants due to the tough salt crust that can develop on the soil surface, low soil permeability, a hard and dry appearance, and dispersion of soil particles (Tanji, 1990). They are strongly to very strongly alkaline, with a pH at or above 8.5, which also limits growth. Further, sodic soils can also be identified in the laboratory as having a sodium adsorption ratio (SAR) of the saturated paste extract of 13 and greater (Davis et al., 2007).

2.2 Classification and Properties of Salt-Affected Soils

Saline non-sodic soils are flocculated, and contain enough salts to disrupt the growth cycle of most plants. To be classified as a saline soil, electrical conductivity of a saturated paste extract (EC_e) is 4 dS/m or greater, with a SAR of less than 13. The pH of these soils is generally less than 8.5 (Provin and Pitt, 2004). Permeability is usually good, and the primary solution for reclaiming these soils is leaching.

The NRCS recognizes five classes of soils based on salinity: non-saline (EC_e < 2 dS/m), very slightly saline (EC_e 2 to < 4 dS/m), slightly saline (EC_e 4 to < 8 dS/m), moderately saline (EC_e 8 to < 16 dS/m), and strongly saline ($EC_e \geq 16$ dS/m). An EC_e of 4 dS/m is classed as slightly saline, and moderately to severely limiting to plant growth (Scianna, et al., 2007). Saline-sodic soils are similar to saline soils as they are also flocculated, the soil permeability is good, the pH is less than 8.5 (Provin and Pitt, 2004) and the EC_e is 4 dS/m or greater. These soils, however, have a SAR of 13 or greater (ESP of $\geq$ 15%). Saline-sodic soils contain a greater amount of Na relative to Mg and Ca and when leached, they become non saline-sodic.

Sodic soils contain higher amounts of dispersed clay, usually created by a high quantity of Na^+ ions relative to Ca^{2+} and Mg^{2+}. Sodic soils have an EC_e of less than 4 dS/m and an SAR of 13 or greater (ESP $\geq$ 15%). These soils are difficult to leach due to poor permeability induced by dispersion of clays and poor structure. When water penetrates the soil surface, the soil can become sticky causing these soils to clod and create a crust on the surface when dry. They are strongly or very strongly alkaline with a pH of 8.5 or above, which causes them to be poorly suited for plants. Sodic soils seldom occur in very sandy soils because of their lack of clay (Provin and Pitt, 2004).

2.3 Reclaiming Salt-Affected Soils

Poor drainage causes salts to build up and is the leading cause of soil salinity (Blaylock, 1994). To leach a highly saline soil as much as 122 cm of water may be required. However, there are several factors that can limit leaching: (i) large amounts of clay, (ii) soil compaction, (iii) high sodium content, and (iv) a high water table (Provin and Pitt, 2004).

Improving soil drainage is beneficial in correcting saline soils. Large amounts of soluble salts can lead to aggregation of the clays contained in the soil increasing soil permeability. However, large amounts of Na salts can decrease soil permeability, especially if the soil exceeds more than 10% of exchangeable Na (Thompson and Walworth, 2006). Tilling or aerating breaks up the soil surface and restrictive subsoil horizons allowing water to leach salts past the root zone. No known amendments can directly control soil salinity leaving leaching of salts below the root zone as the only management tool (Thompson and Walworth, 2006).

Leaching is effective in removing salts from the soil, but requires good internal drainage and structure. Leaching occurs when water infiltrates the soil, dissolving excess salts which moves the solute below the root zone. Leaching occurs naturally throughout the year by precipitation, or can be facilitated with a low salt content irrigation water (total salts not to exceed 1,500-2,000 ppm) applied to the soil surface (Provin and Pitt, 2004).

In areas with shallow water tables or a restricting soil horizon, wicking of salts can occur through capillary forces. This occurs when evaporation exceeds precipitation during dry conditions. Brady and Weil (2002) state that the finer the pore size, the higher the water will rise, bringing salts towards the surface. Capillary rise can be calculated using the equation $h=0.15/r$, where h equals the height of rise (cm) and r is the radius of the pore (Brady and Weil, 2002). The replacement of Na^+ by Ca^{2+} on the colloids facilitates flocculation and subsequent leaching of the displaced Na^+.

In addition to improving the drainage of saline-sodic and non saline-sodic soils, gypsum can be added to the soil to reduce the exchangeable Na content within the soil by replacing Na^+ with Ca^{2+} on the soil colloid (Provin and Pitt, 2004).

2.4 Soils Affected by Sea Water

After an event such as a tsunami or a hurricane storm surge, salinity would affect the topsoil more than the subsoil (McLeod et al., 2009). Storm surges have not been found to permanently change or eliminate vegetation in an area, but have been found to temporarily raise the salinity in soils and contribute to erosion and sedimentation. Most storm surges from hurricanes are associated with heavy rains that can flush salt from the soil allowing plants to regenerate at a much quicker rate. Hurricane Hugo was an exception, as little rain was associated with the storm (ca. 21-65 mm). Due to a two month dry period, the soils were not immediately flushed of salts generating a longer term salinity problem following a storm surge (Williams et al., 1999).

3. MATERIALS AND METHODS

3.1 Site Selection and Sampling

This research study includes soil samples taken by NRCS cooperators on four separate occasions (November 2008, April 2009, December 2009, and October 2010) following Hurricane Ike, from selected sites in Chambers, Jefferson, and Orange Counties. The samples represent soils located in the Gulf Coast Prairies and the Gulf Coast Saline Prairies Major Land Resource Areas and include Alfisols, Mollisols, Vertisols, Entisols, and Inceptisols.

Sites were selected using a stratified pattern so as to obtain samples from three areas (non-surge, edge, and surge) located within each of the counties. Non-surge area samples are from areas that did not receive the storm surge, and were analyzed to suggest background salinity levels. Edge area samples are from areas that received 30 to 90 cm of storm surge, and the surge area samples received 90 to 380 cm of storm surge. Composite bulk samples were from 56 pedons at four depths (0-5 cm, 5-15 cm, 15-30 cm, and 30-50 cm) across seven soil series in the three counties. Figure 1 shows the sample locations in reference to the three counties. Appendix A gives Site Identifications which correspond to Fig. 1, along with the respective surge area, county, and identification numbers used in the analyses in the laboratories.

3.2 Soil Analysis

Samples were air-dried, ground to pass a 2-mm sieve and analyzed for electrical conductivity of the saturated paste extract (EC_e), and water soluble Ca^{2+}, Mg^{2+}, and Na^+ in order to calculate sodium adsorption ratio (SAR) of the saturated paste extract. Twenty-eight of the collected samples were analyzed for exchangeable sodium percentage (ESP) at the Soil Characterization Laboratory at Texas A&M University.

For the EC_e analysis, distilled water was added to a 200 g soil sample and stirred with a spatula until the mixture began to flow, then the saturated paste was allowed to stand overnight. The saturated paste was then placed into a filter funnel (Whatman No. 42 filter paper was used for this study), connected to a syringe and extracted until the extract volume in the syringe was sufficient. The EC_e was determined using an electrical conductivity meter (Richards, 1954).

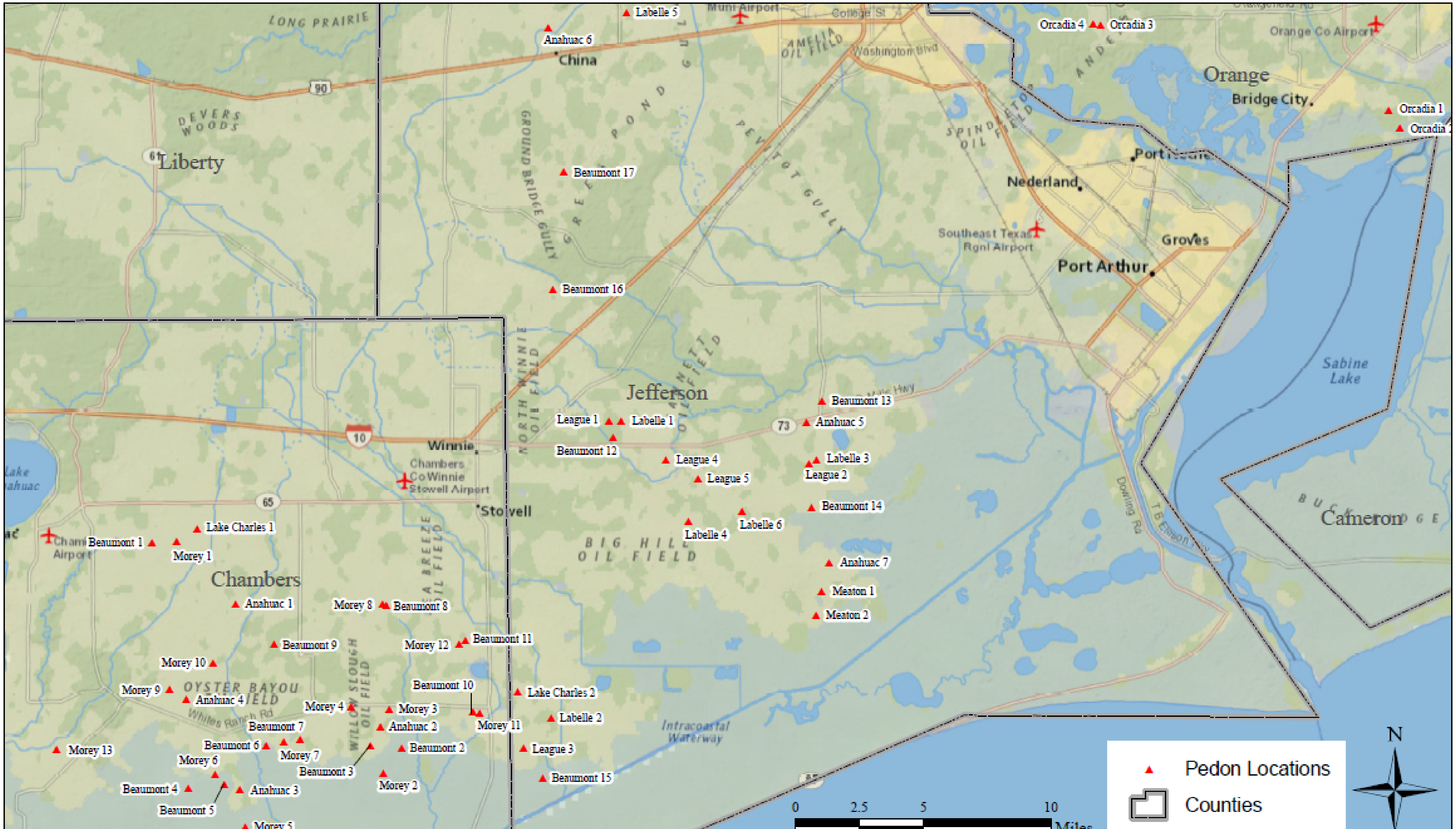

Fig. 1. Location of pedons sampled for the study. (Pedons are identified by series name and a number)

Soluble bases in the saturated paste extract were determined by atomic absorption and flame emission. Sodium and K concentrations in the extract were determined by flame emission on an atomic absorption spectrometer and Ca and Mg by atomic absorption using a N_2O-acetylene flame (Hallmark et al., 1986). The SAR was calculated using the equation $SAR = Na^{+} / ((Ca^{2+} + Mg^{2+})/2)^{1/2}$. The SAR suggests the amount of exchangeable Na on colloid exchange sites, but the commonly used relationship is established in a restricted geographical region where soils are of mixed clay mineralogy, and many are non-calcareous, and likely contained no exchangeable Al. Therefore, about 30 samples representing a range of soils and SAR values were selected for determination of cation exchange capacity (Holmgren et al., 1977; Soil Survey Staff, 1996) and extractable Na (Holmgren et al., 1977; Soil Survey Staff, 1996). Exchangeable Na was calculated by correcting extractable Na as determined in the saturated paste extract. Exchangeable Na = [Extractable Na – (soluble Na)(saturation percentage)(0.001)] where exchangeable and extractable Na are in cmol(+)/kg, soluble Na as mmol(+)/L, and saturation percentage as g water/100g soil.

Soil reaction (pH) was measured on a 1:1 soil/water extract using a glass electrode (Soil Survey Laboratory Staff, 1996). A soil sample (30 g) was mixed with an equal weight (30 ml) of distilled water and stirred at 15-min intervals for one hour. Then, the suspension was stirred again, and pH was measured.

3.3 Statistical Analysis

The EC and SAR were evaluated to determine the relationship between the initial salt load and depth of inundation and determine the effect of time on soil salt levels using two years (4 sample sets) of sampling data. In addition to descriptive statistics (mean, standard deviation) and graphics (columnar and line plots), group comparisons between non-surge, edge, and surge soils were made to evaluate salinity and sodicity differences with depth and over time. The relationship of ESP and SAR was graphed and tested using linear regression.

4. RESULTS AND DISCUSSION

4.1 Soil Classification

The soils used in this study are given in Table 1, along with their classification at the family level (Soil Survey Staff, 2010). All soil information was current in the Natural Resources Conservation Service official soil series description available online at http://soils.usda.gov/technical/classification/osd/index.html accessed May 2012. The study soils in Chambers County were the Anahuac, Beaumont, Lake Charles, and Morey series. Anahuac is classified as a fine, mixed, active, hyperthermic Oxyaquic Glossudalf. Anahuac soils formed in loamy and clayey alluvial sediments on uplands of Pleistocene age. The sites in this series are primarily used as pastureland. The Beaumont series formed in clayey sediments of Pleistocene age and is classified as a fine, smectitic, hyperthermic Chromic Dystraquert. The sites are used primarily as pastureland and rice fields. Lake Charles is classified as a fine, smectitic, hyperthermic Typic Hapludert. These soils are very slowly permeable soils that formed in clayey sediments, and are used primarily as pastureland and rice fields. The Morey series is a fine-silty, siliceous, superactive, hyperthermic Oxyaquic Argiudoll formed in silty sediments of Pleistocene age. Morley is used primarily for pasture and rice.

The study soils in Jefferson County were the Anahuac, Beaumont, Labelle, League, and Meaton series. The Labelle series is a fine, smectitic, hyperthermic Oxyaquic Vertic Argiudoll. This soil is very deep, somewhat poorly drained, very slowly permeable and formed in loamy and clayey sediments on nearly level uplands of Pleistocene age. Labelle is used primarily for rice, but also includes limited pastureland.

League is classified as a fine, smectitic, hyperthermic Oxyaquic Dystrudert. This is a very deep, somewhat poorly drained, very slowly permeable soil formed in clayey sediments on uplands of Pleistocene age. League soils are nearly level and are used primarily for rice. The Meaton series is classified as a fine-silty, siliceous, superactive, hyperthermic Typic Argiaquoll and consists of very deep, somewhat poorly drained, slowly permeable soils formed in loamy and clayey sediments on nearly level uplands of Pleistocene age.

The soil series in Orange County was the Orcadia series. Orcadia is a fine, smectitic, hyperthermic Oxyaquic Glossudalf, and consists of very deep, somewhat poorly drained, very slowly permeable soils. These soils formed in loamy and clayey sediments on nearly level uplands of Pleistocene age.

Table 1. Soil series selected for the study and their classification.

County	Soil Series	Family Classification
Chambers	Anahuac	Fine, mixed, active, hyperthermic Oxyaquic Glossudalfs
	Beaumont	Fine, smectitic, hyperthermic Chromic Dystraquerts
	Lake Charles	Fine, smectitic, hyperthermic Typic Hapluderts
	Morey	Fine-silty, siliceous, superactive, hyperthermic Oxyaquic Argiudolls
Jefferson	Anahuac	Fine, mixed, active, hyperthermic Oxyaquic Glossudalfs
	Beaumont	Fine, smectitic, hyperthermic Chromic Dystraquerts
	Labelle	Fine, smectitic, hyperthermic Oxyaquic Vertic Argiudolls
	League	Fine, smectitic, hyperthermic Oxyaquic Dystruderts
	Meaton	Fine-silty, siliceous, superactive, hyperthermic Typic Argiaquolls
Orange	Orcadia	Fine, smectitic, hyperthermic Oxyaquic Glossudalfs

4.2 Soil Salinity Levels: November 2008

Soil salinity was first evaluated after Hurricane Ike in November 2008, and the results are given in Appendix B, which presents data obtained at the NRCS and Soil Characterization Laboratories. Samples from the non-surge area represent salinity levels for soils which were not impacted by the hurricane's storm surge, and should act as a baseline for comparison of the salts resulting from sea water in the surge area. Samples from the "Edge" represent an area where the hurricane's storm surge ranged in depth from 30 to 90 cm. Samples from the "Surge" represent areas that were inundated with 90 to 380 cm of sea water. To facilitate comparisons of "plow layers", the 0-5 cm and 5-15 cm samples at each site were depth-arranged to give a weighted mean. These data are presented in Table 2 and serve as the data base for statistical comparisons.

The EC_e for the first sample set (November 2008) 0-15 cm soil samples ranged from 0.3 to 3.9 dS/m in the non-surge area, 0.9 to 12.6 dS/m in the edge area and from 1.6 to 26.7 dS/m in the surge area. The EC_e for the first sample set 15-30 cm soil samples studied ranged from 0.1 to 4.2 dS/m in the non-surge area, 0.6 to 6.8 dS/m in the edge area, and 0.3 to 14.6 dS/m in the surge area.

Table 2. Salinity levels (electrical conductivity of the saturated paste extract, EC_e) by area and depth for the selected soils about two months after Hurricane Ike. Samples were taken November 2008.

Site ID	Soil Depth	EC_e
	cm	dS/m
------------------------Non-Surge-----------------------		
Anahuac 1	0-15	1.3
	15-30	2.0
Anahuac 6	0-15	1.2
	15-30	0.1
Beaumont 1	0-15	3.9
	15-30	4.2
Beaumont 16	0-15	0.4
	15-30	0.4
Beaumont 17	0-15	1.2
	15-30	0.6
Labelle 5	0-15	0.3*
	15-30	0.3*
Lake Charles 1	0-15	3.1
	15-30	2.4
Morey 1	0-15	2.1
	15-30	1.6
--------------------------Edge--------------------------		
Anahuac 4	0-15	1.9
	15-30	0.9
Beaumont 8	0-15	2.2*
	15-30	2.5*
Beaumont 9	0-15	12.6
	15-30	3.4
Beaumont 12	0-15	10.1*
	15-30	1.5*
Beaumont 13	0-15	11.0
	15-30	3.9
Labelle 1	0-15	11.2
	15-30	2.8
League 1	0-15	9.0
	15-30	2.0
Morey 8	0-15	1.7
	15-30	1.0

Table 2. (continued)

Site ID	Soil Depth	EC_e
	cm	dS/m
--------------------Edge (continued) --------------------		
Morey 9	0-15	1.2*
	15-30	0.6*
Morey 10	0-15	8.0*
	15-30	6.8*
Orcadia 4	0-15	0.9*
	15-30	0.7*
--------------------------Surge--------------------------		
Anahuac 2	0-15	10.4
	15-30	1.6
Anahuac 3	0-15	15.5*
	15-30	10.2*
Anahuac 5	0-15	3.9
	15-30	0.3
Anahuac 7	0-15	5.3*
	15-30	3.0*
Beaumont 2	0-15	26.7*
	15-30	2.5*
Beaumont 3	0-15	20.5*
	15-30	6.6*
Beaumont 4	0-15	19.9*
	15-30	8.4*
Beaumont 5	0-15	18.5
	15-30	14.6
Beaumont 6	0-15	10.6*
	15-30	2.0*
Beaumont 7	0-15	4.4*
	15-30	2.8*
Beaumont 10	0-15	22.7*
	15-30	3.3*
Beaumont 11	0-15	7.3*
	15-30	1.5*
Beaumont 14	0-15	9.9
	15-30	2.4
Beaumont 15	0-15	8.8*
	15-30	6.8*

Table 2. (continued)

Site ID	**Soil Depth**	**EC_e**
	cm	dS/m
--------------------Surge (continued)---------------------		
Labelle 2	0-15	7.6*
	15-30	8.1*
Labelle 3	0-15	8.3
	15-30	1.9
Labelle 4	0-15	3.7*
	15-30	0.8*
Labelle 6	0-15	5.5*
	15-30	1.1*
Lake Charles 2	0-15	10.4
	15-30	3.2
League 2	0-15	16.8
	15-30	2.5
League 3	0-15	7.4*
	15-30	3.6*
League 4	0-15	1.6*
	15-30	0.5*
League 5	0-15	15.2*
	15-30	0.6*
Meaton 1	0-15	3.6*
	15-30	1.2*
Meaton 2	0-15	3.6*
	15-30	2.0*
Morey 2	0-15	12.6*
	15-30	4.8*
Morey 3	0-15	7.1*
	15-30	2.1*
Morey 4	0-15	8.3*
	15-30	3.8*
Morey 5	0-15	10.7*
	15-30	7.2*
Morey 6	0-15	11.0*
	15-30	4.8*
Morey 7	0-15	14.1*
	15-30	4.2*

Table 2. (continued)

Site ID	Soil Depth	EC_e
	cm	dS/m
---------------------Surge (continued)----------------------		
Morey 11	0-15	11.4*
	15-30	2.9*
Morey 12	0-15	8.1*
	15-30	2.6*
Morey 13	0-15	4.3
	15-30	3.5
Orcadia 1	0-15	1.9*
	15-30	0.9*
Orcadia 2	0-15	2.0*
	15-30	0.8*
Orcadia 3	0-15	2.8*
	15-30	1.2*

* NRCS data developed in field office laboratory. All other values from the Soil Characterization Laboratory, Texas A&M University in College Station.

The soil salinity immediately following the storm surge was highly variable across the sea water inundated landscape. Non-surge affected soil samples were taken to obtain the background soil salinity levels for the area. From the non-surge soil samples only Beaumont 1 was slightly saline in the 15-30 cm zone. The remaining non-surge sites were non-saline to very slightly saline according to NRCS salinity classes (Scianna, et al., 2007). The percent of samples in each of the salinity classes is depicted in Fig. 2. As the depth of sea inundation increased from the non-surge area to the surge area, the number of sites that are at least slightly saline (≥ 4 dS/m) increased. In the 0-15 cm depth of the edge area, 36% were non-saline, 9% of the sites were very slightly saline, 9% were slightly saline, and 45% were moderately saline. In the 15-30 cm profile within the edge area, 45% were non-saline, 36% of the sites were very slightly saline, and 9% were slightly saline. In the 0-15 cm profile within the surge area, 8% were non-saline, 14% of the sites were very slightly saline, 22% were slightly saline, 41% were moderately saline, and 16% were strongly saline. In the 15-30 cm profile within the surge area, 38% were non-saline, 32% of the sites were very slightly saline, 19% were slightly saline, and 11% were moderately saline.

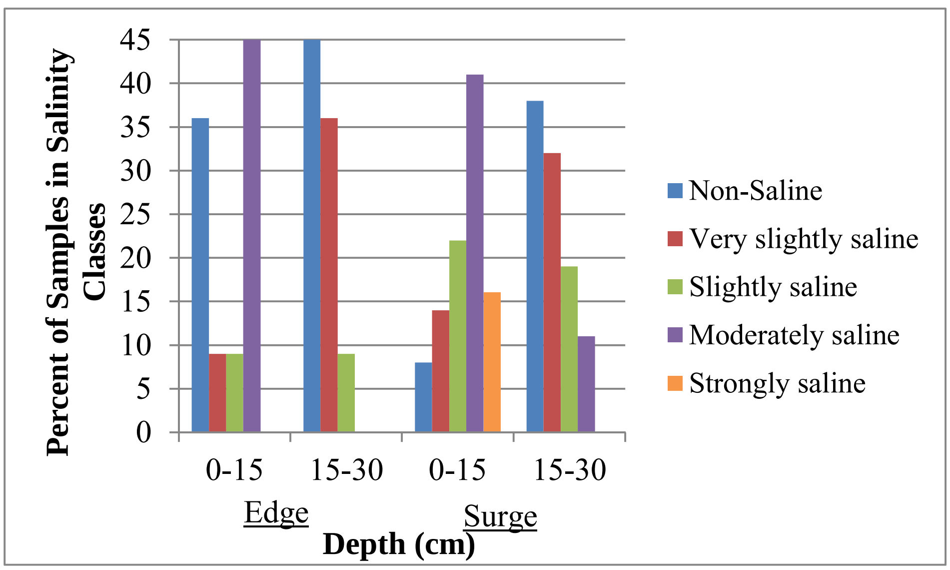

Fig. 2. Percent of samples in the edge and surge areas in salinity classes (November 2008).

4.3 Soil Salinity Levels: April 2009

Samples for EC_e for the second sample set were taken in April 2009, and the results appear in Appendix B and Table 3. Again, Table 3 combines the 0-5 cm and the 5-15 cm layers to give the salinity level in the plow layer. The surface soil samples studied ranged from 1.5 to 16.6 dS/m in the edge area and from 1.2 to 23.2 dS/m in the surge area. The EC_e for the second sample set of 15-30 cm samples studied ranged from 0.3 to 4.2 dS/m in the edge area and 0.9 to 12.8 dS/m in the surge area.

Table 3. Salinity levels (electrical conductivity of the saturate paste extract, EC_e) by area and depth for soils about seven months after Hurricane Ike. Samples were taken April 2009.

Site ID	Soil Depth	EC_e
	cm	dS/m
---------------------------Edge---------------------------		
Beaumont 8	0-15	3.4*
	15-30	2.2*
Beaumont 12	0-15	3.3*
	15-30	2.3*
Beaumont 13	0-15	5.6
	15-30	4.2
Labelle 1	0-15	6.0
	15-30	2.5*
League 1	0-15	16.6
	15-30	2.5*
Morey 9	0-15	1.5*
	15-30	0.7*
Morey 10	0-15	2.2*
	15-30	2.5*
Orcadia 4	0-15	6.4*
	15-30	0.3*
---------------------------Surge---------------------------		
Anahuac 2	0-15	7.2
	15-30	2.2*
Anahuac 5	0-15	3.5
	15-30	0.9*
Anahuac 7	0-15	12.7
	15-30	3.9*
Beaumont 2	0-15	14.0
	15-30	4.4
Beaumont 3	0-15	12.2
	15-30	7.3

Table 3. (continued).

Site ID	Soil Depth	EC_e
	cm	dS/m
---------------------Surge (continued)---------------------		
Beaumont 4	0-15	7.4
	15-30	5.9
Beaumont 6	0-15	7.9
	15-30	3.4*
Beaumont 7	0-15	3.7*
Beaumont 10	0-15	23.2
	15-30	7.2
Beaumont 11	0-15	3.2
	15-30	2.3*
Beaumont 15	0-15	8.5
	15-30	10.7
Labelle 2	0-15	6.0
Labelle 3	0-15	5.5
	15-30	2.8*
Labelle 4	0-15	2.9*
	15-30	2.7*
Labelle 6	0-15	9.0
	15-30	1.9*
League 3	0-15	5.0
	15-30	5.1
League 4	0-15	2.2*
	15-30	1.7*
League 5	0-15	3.8*
	15-30	2.8*
Meaton 1	0-15	6.9
	15-30	2.3*
Meaton 2	0-15	22.5
	15-30	6.9
Morey 2	0-15	9.6
	15-30	6.4
Morey 3	0-15	12.3
Morey 4	0-15	3.4
	15-30	3.5*

Table 3. (continued).

Site ID	Soil Depth	EC_e
	cm	dS/m
---------------------Surge (continued)---------------------		
Morey 5	0-15	11.6
	15-30	10.6
Morey 6	0-15	8.3
	15-30	12.8
Morey 7	0-15	17.2
Morey 11	0-15	5.4
	15-30	8.9
Morey 12	0-15	2.7*
	15-30	2.8*
Morey 13	0-15	7.0*
	15-30	3.3
Orcadia 1	0-15	1.2*
	15-30	1.1*
Orcadia 2	0-15	8.6
	15-30	1.6
Orcadia 3	0-15	11.2
	15-30	2.4*

*NRCS data developed in field office laboratory. All other values from the Soil Characterization Laboratory, Texas A&M University in College Station.

The percent of samples in each of the salinity classes is depicted in Fig. 3. The figure shows that the percentage of salt-affected soils (classes of slightly saline and above) is greater in the surge area as compared to the edge area. In the 0-15 cm samples from the edge area, 13% were non-saline, 38% of the sites were very slightly saline, and 38% were slightly saline. In the 15-30 cm profile within the edge area, 25% were non-saline, 50% of the sites were very slightly saline, and 13% were slightly saline. In the 0-15 cm profile within the surge area, 3% were non-saline, 25% of the sites were very slightly saline, 28% were slightly saline, 34% were moderately saline, and 9% were strongly saline. In the 15-30 cm profile within the surge area, 18% were non-saline, 43% of the sites were very slightly saline, 25% were slightly saline, and 14% were moderately saline.

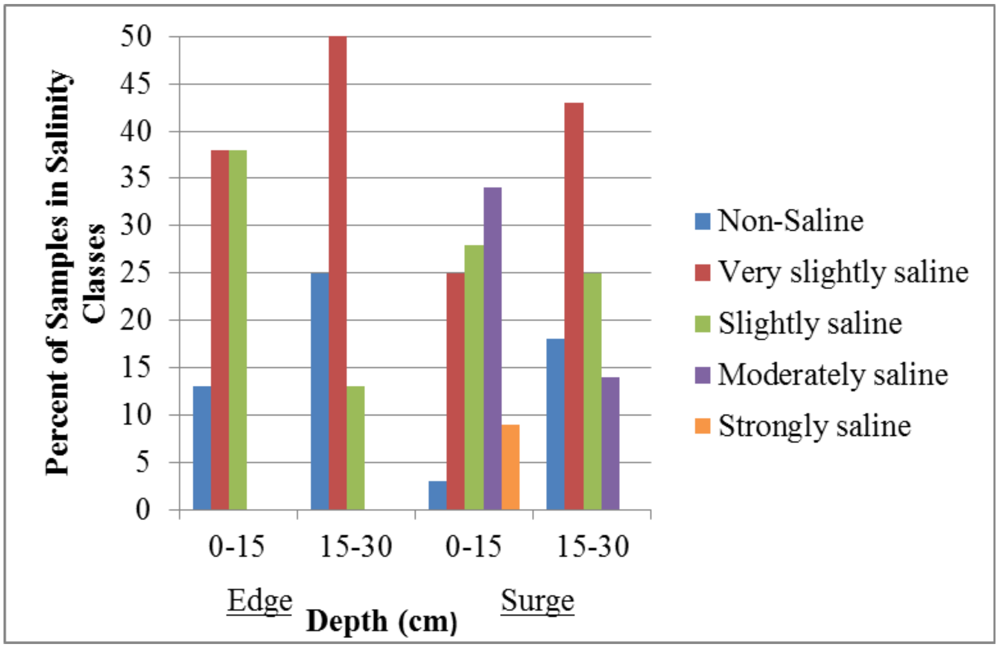

Fig. 3. Percent of samples in the edge and surge areas in salinity classes (April 2009).

4.4 Soil Salinity Levels: December 2009

Results of the EC_e values from soil samples taken about 15 months after inundation are given in Table 4. The surface soil samples ranged from 0.2 to 2.9 dS/m in the edge area and from 0.8 to 16.9 dS/m in the surge area. The EC_e for the third sample set subsoil samples studied ranged from 1.5 to 6.7 dS/m in the surge area.

Table 4. Salinity levels (electrical conductivity of the saturated paste extract, ECe) by area and depth for soils about fifteen months after Hurricane Ike. Samples were taken December 2009.

Site ID	Soil Depth	EC_e
	cm	dS/m
--------------------------Edge--------------------------		
Anahuac 4	0-15	1.0
Beaumont 9	0-15	0.3
Labelle 1	0-15	1.2
League 1	0-15	2.9
Morey 9	0-15	0.2
Morey 10	0-15	0.5
--------------------------Surge--------------------------		
Anahuac 2	0-15	0.8
Anahuac 7	0-15	0.9
Beaumont 10	0-15	12.7
Beaumont 11	0-15	1.6
Labelle 3	0-15	1.5
Labelle 6	0-15	6.1
League 5	0-15	1.2
Meaton 1	0-15	3.1
Morey 3	0-15	2.4
Morey 4	0-15	16.9
Morey 11	0-15	3.4
	15-30	6.7
Morey 12	0-15	0.8
Morey 13	0-15	1.8
	15-30	2.2
Orcadia 1	0-15	0.9
	15-30	1.5
Orcadia 2	0-15	3.7

The percentage of samples in each of the salinity classes is depicted in Fig. 4 for the EC_e of the third sample set (December 2009). In the 0-15 cm samples within the edge area, 83% were non-saline, 17% of the sites were very slightly saline. In the 0-15 cm profile within the surge area, 53% were non-saline, 27% of the sites were very slightly saline, 7% were slightly saline, 7% were moderately saline, and 7% were strongly saline. In the 15-30 cm profile within the surge area, 33% were non-saline, 33% of the sites were very slightly saline, and 33% were slightly saline.

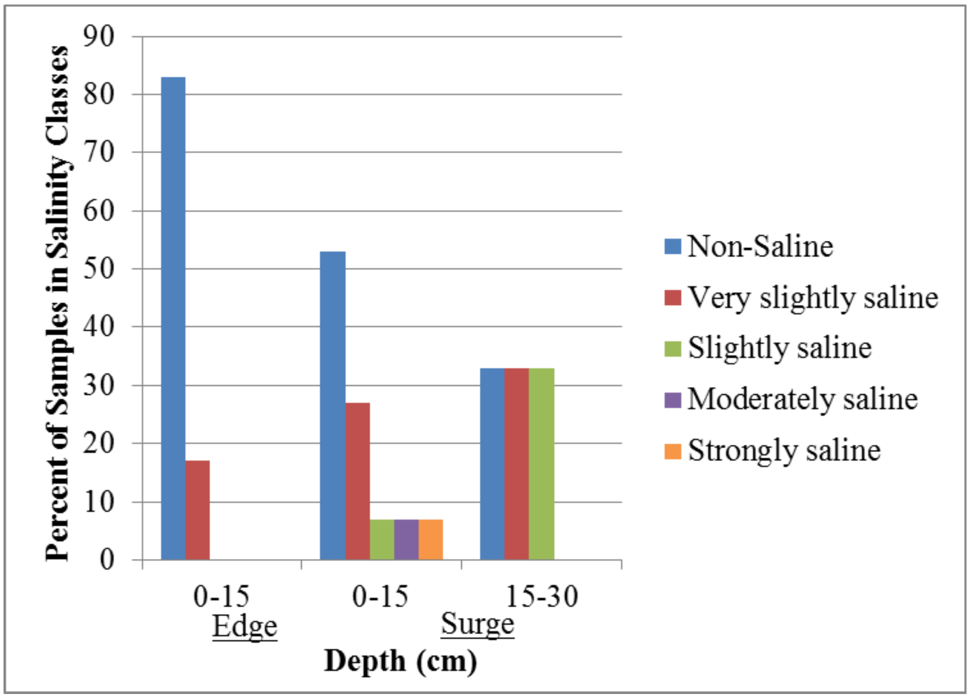

Fig. 4. Percent of samples in salinity classes (December 2009).

4.5 Soil Salinity Levels: October 2010

The EC_e for the fourth sample set (October 2010) surface soil samples studied ranged from 0.3 to 1.0 dS/m in the edge area and from 0.6 to 1.9 dS/m in the surge area. The EC_e for the fourth sample set subsoil samples studied ranged from 0.3 to 1.6 dS/m in the edge area and 0.7 to 3.8 dS/m in the surge area.

Table 5. Salinity levels (electrical conductivity of the saturated paste extract, EC_e) by area and depth for the selected soils about twenty-five months after Hurricane Ike. Samples were taken October 2010.

Site ID	Soil Depth	EC_e
	cm	dS/m
	---------------------------Edge---------------------------	
Anahuac 4	0-15	0.3
	15-30	0.3
League 1	0-15	1.0
	15-30	1.6
	---------------------------Surge---------------------------	
Anahuac 2	0-15	0.8
	15-30	1.4
Beaumont 2	0-15	1.7
	15-30	3.8
Labelle 3	0-15	1.9
	15-30	1.2
Orcadia 1	0-15	0.6
	15-30	0.7
Orcadia 2	0-15	1.8
	15-30	3.3

The percent of samples in each of the salinity classes is depicted in Fig. 5. Table 5 gives the salinity levels by area and depth for the fourth sample set, approximately 25 months after inundation by Hurricane Ike. The mean EC_e for the fourth sample set surface soil samples were: 0.7 for the edge area, and 1.4 for the surge area. In the 0-15 cm profile within the edge area, as well as in the 15-30 cm profile within the edge area, the soil was 100% non-saline. In the 0-15 cm profile within the surge area all sites are non-saline. However, in the 15-30 cm profile within the surge area, 60% were non-saline, and the remaining 40% of the sites were very slightly saline. No soil samples showed an EC_e above 4.0 dS/m.

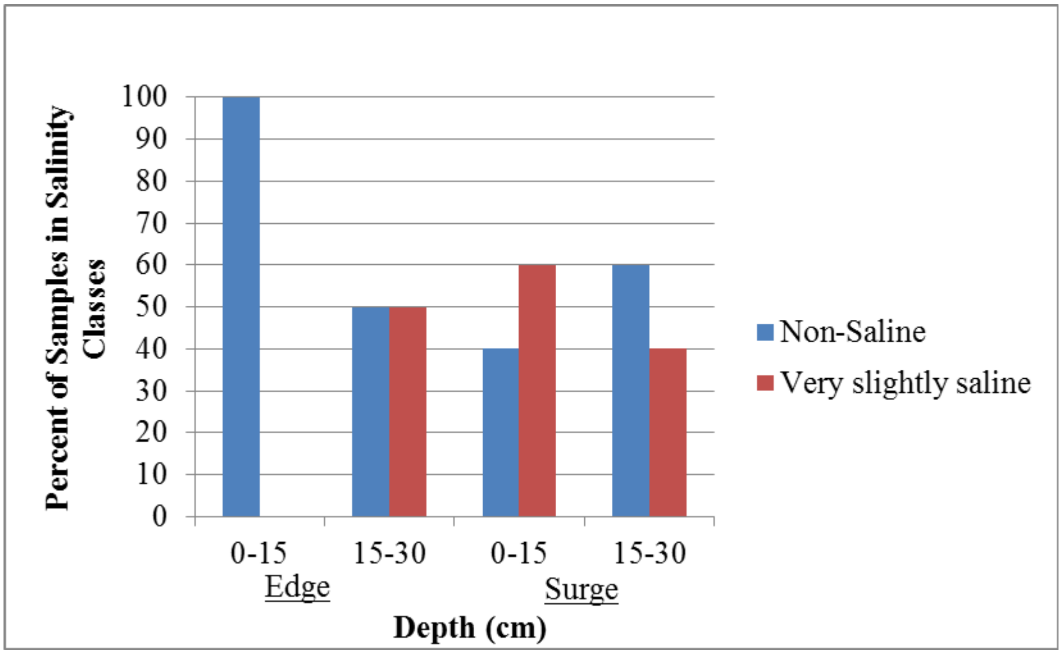

Fig. 5. Percent of samples in salinity classes (October 2010)

4.6 Change in Salinity with Time

Soil salinity is recognized as being a log normal distributed variable (Wilding and Drees, 1983) so statistical analyses should be by log normal transformations. Since areas and sampling times were represented by different numbers of soils, t-tests by group comparisons using log-normal transformations were used. Results for the comparisons are given in Table 6 and the geometric means for the groups are presented in Table 7.

At the time of the first sampling following the surge of sea water, there was a highly significant difference in EC_e means in the surface soils in the surge versus non-surge areas (Table 6). This highly significant difference persisted until the third sampling period when the two groups were statistically similar. Similarly, the edge-non surge comparisons of the surface soils were significantly different at the 95% level (99% level at the second sampling) but were statistically similar by the third sampling period.

Table 6 also suggests that sea water affected only the surface 0-15 cm and not the 15-30 cm subsoil zone in the edge area as the subsoil comparisons between edge and non-surge areas were not significantly different. However, by the third sample set, about one year following the storm surge, there was no statistical difference among any of the areas and depths except for the surge versus edge of the surfaces. This difference was not noted within the fourth sample set.

Table 6. Salinity comparisons of geometric means (log EC_e) by group t-tests for areas and soil depths.

	t-value			
Group Comparisons	**Sample Set 1**	**Sample Set 2**	**Sample Set 3**	**Sample Set 4**
Edge - Non-surge 0-15	2.69*	3.04**	1.13	1.2
Edge - Non-surge 15-30	1.39	1.23	No data	0.36
Surge - Edge 0-15	2.06*	1.56	2.11*	1.48
Surge - Edge 15-30	1.16	2.08*	No data	1.14
Surge - Non-surge 0-15	5.68**	5.35**	1.38	0.27
Surge - Non-surge 15-30	2.46*	3.44**	0.68	0.96

* = significant (95%)
** = highly significant (99%)

Table 7. Group geometric means of EC_e (dSm^{-1}) over time.

Groups	Sample Set 1	Sample Set 2	Sample Set 3	Sample Set 4
Non-Surge 0-15 cm	1.7	1.7*	1.7*	1.7*
Non-Surge 15-30 cm	1.5	1.5*	1.5*	1.5*
Edge 0-15 cm	6.3	5.6	1.0	0.7
Edge 15-30 cm	2.4	2.2	No data	1.0
Surge 0-15 cm	9.7	9.5	3.9	1.4
Surge 15-30 cm	3.5	4.6	3.5	2.1

* = Non-surge data for all sample dates was that of November 2008.

In the six weeks leading to Hurricane Ike, 37 cm of precipitation fell at the Anahuac National Wildlife Refuge (NWR) in Chambers County (Western Regional Climate Center, 2011). The average precipitation for the year is 136 cm to include an average of 12 cm in the month of August and 14 cm in September (Western Regional Climate Center, 2011). This above-average precipitation increased soil moisture and likely reduced the amount of sea water infiltrating the soil. Due to the lack of rain in the six months following the Hurricane Ike storm surge (34.4 cm), the leaching of salt did not occur as rapidly as it would have under the usual amounts of rainfall (66 cm). Rainfall data can be found in Appendix C.

4.7 Change in SAR with Time

At the time of the first sampling following the surge of sea water, there was a highly significant difference in SAR means in the surface soils in the surge versus non-surge areas (Table 8). This highly significant difference persisted until the fourth sampling period when the two groups were statistically similar. Similarly, the edge-non surge comparisons of the surface soils were not significantly different at the 95% level.

However, the second sampling event, approximately six months following the hurricane, there was increase in SAR likely due to the below average rainfall as mentioned above.

Table 9 depicts the decrease of the group geometric means in the SAR levels over the course of two years. On average, one year following Hurricane Ike, the surface 0-15 cm soil profile is non-sodic, and by the fourth sampling event, approximately two years following the hurricane, the surface 0-15 cm soil profile was back to pre-surge SAR levels.

Table 8. Sodium adsorption ratio comparisons of geometric means (log SAR) by group t-tests for areas and soil depths.

	t-value			
Group Comparisons	**Sample Set 1**	**Sample Set 2**	**Sample Set 3**	**Sample Set 4**
Edge - Non-surge 0-15	2.07	2.38*	0.29	0.43
Surge - Edge 0-15	1.56	0.82	2.24*	0.67
Surge - Non-surge 0-15	4.35**	6.75**	2.69**	1.12

* = significant (95%)
** = highly significant (99%)

Table 9. Group geometric means of sodium adsorption ratio over time.

Groups	**Sample Set 1**	**Sample Set 2**	**Sample Set 3**	**Sample Set 4**
Non-Surge 0-15 cm	5.1	5.1*	5.1*	5.1*
Edge 0-15 cm	10.7	12.7	5.5	5.0
Surge 0-15 cm	15.4	15.2	9.9	6.2

* = Non-surge data for all sample dates was that of November 2008.

4.8 SAR to ESP Predictive Equation

Handbook 60 defines the relationship between SAR-ESP as 13 and 15%, respectively, based on studies performed in California on non-calcaraeous soils, and as such has been the set standard (Richards, 1954). This study was designed to determine if the same relationship holds true for calcareous soils in southeast Texas. Twenty-eight soil samples were randomly chosen from the November 2008 sampling for determination of ESP to evaluate the relationship of SAR and ESP. The laboratory results for SAR and ESP are presented in Fig. 6 as a graph using a power regression model. The resulting equation, ESP= $1.19(SAR)^{0.82}$, is highly significant and useful as a predictive tool as the r^2 is 0.929, indicating that the equation explains 92% of the variation between SAR and ESP.

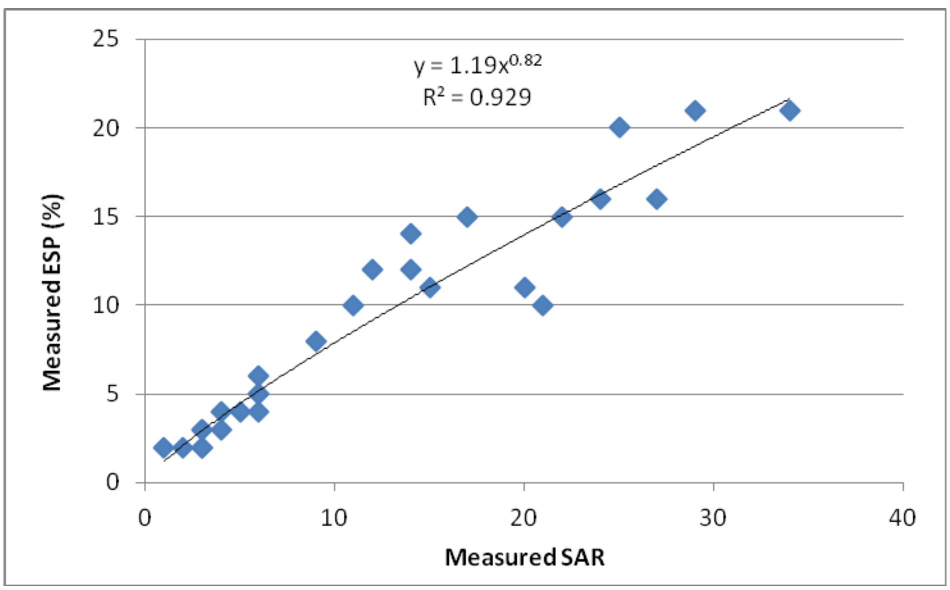

Fig. 6. Measured SAR versus measured ESP (%) showing relationship

The SAR-ESP relationship is statistically significant (95% confidence level), with a correlation coefficient of 0.964 (df=26). In viewing Fig. 6, the first occurrence of ESP equaling 15% occurs when SAR equals 17.

5. SUMMARY AND CONCLUSIONS

In September 2008, Hurricane Ike hit the Texas Gulf Coast with a force stronger than the category 2 storm that it was rated. With a 3.8 m (12.5 ft) storm surge, the agricultural industry in the area was devastated. The goal of this research was to determine the length of time required to leach the salt loads brought in with the storm surge. To do this, four sets of samples were taken across two years and analyzed for EC_e and SAR using the saturated paste extract method.

The heavy rainfall in the six weeks leading up to Hurricane Ike was adequate to thoroughly wet the soil minimizing the amount of surge water that infiltrated into the soils. As all the study soils of the surge area had clayey subsoils with smectite-dominated clays, hydraulic conditions would limit infiltration. Following the hurricane, there was a significant lack of rainfall, which attributed to the slow process of leaching salt from the soil in the first few months. Only 36 cm of rainfall fell between the hurricane event and the second sampling event in April 2009.

Base levels of salinity were assumed to be that represented by soils of the non-surge areas. The initial salt levels in November 2008 were significantly greater in the surge and edge areas as compared to the non-surge areas. Fifty-four percent of the soils sampled in the 0-15 cm horizon and 9% in the 15-30 cm horizon of the edge area had an $EC_e \geq 4$ dS/m. In the surge area 79% of the soils sampled in the 0-15 cm horizon and 30% in the 15-30 cm horizon had an $EC_e \geq 4$ dS/m.

In April 2009, salinity levels in the surface soils of the edge and surge areas remained above the non-surge soils. Thirty-eight percent of the soils sampled in the 0-15 cm horizon and 13% in the 15-30 cm horizon of the edge area had an $EC_e \geq 4$ dS/m. In the surge area 71% of the soils sampled in the 0-15 cm horizon and 39% in the 15-30 cm horizon had an $EC_e \geq 4$ dS/m.

By December 2009, all of the soils sampled in the edge area had an EC_e below 4 dS/m, while in the surge area, 21% of the soils sampled in the 0-15 cm horizon and 33% in the 15-30 cm horizon had an $EC_e \geq$ 4dS/m. All soils sampled in October 2010 had lost enough salts to be classified as non-saline to very slightly saline soils (< 4 dS/m).

This study shows that the soils in the inundated areas needed between one and two years for salt leaching to return to agriculture production in the area. Farmers could expect to return to farming rice and other crops in their fields and ranchers could re-establish suitable forage for livestock between one and two years depending on salt tolerance.

Utilizing the November 2008 data set, 28 random samples were analyzed for SAR and ESP in order to develop an ESP-SAR predictive equation, $ESP = 1.19(SAR)^{0.82}$. The SAR-ESP relationship was statistically significant (95% confidence level with a correlation coefficient of 0.964).

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APPENDIX A

SITE IDENTIFICATION

Site ID	Pedon ID	Lab ID	County	Area
Anahuac 1	S08TX071004	E2376-E2378	Chambers	Non-Surge
Anahuac 2	S08TX071008	E2403-E2406	Chambers	Surge
	S09TX0713098	E3017-E3018		
	S09TX0712358	E3040-E3041		
	S10TX0713091	E3636-E3639		
Anahuac 3	S08TX071018	NRCS Lab	Chambers	Surge
Anahuac 4	S08TX071024	E2391-E2394	Chambers	Edge
	S10TX00713092	E3640-E3643		
Anahuac 5	S08TX245005	E2447-2449	Jefferson	Surge
	S09TX2453104	E2736		
Anahuac 6	S08TX24514	E2419-E2422	Jefferson	Non-Surge
Anahuac 7	S08TX24523	NRCS Lab	Jefferson	Surge
	S09TX2452171	E3028-E3029		
	S09TX2452364	E3051-E3052		
Beaumont 1	S08TX071001	E2379- E2382	Chambers	Non-Surge
Beaumont 2	S08TX071006	NRCS Lab	Chambers	Surge
	S09TX0713096	E2728-E2731		
	S10TX0713090	E3632-E3635		
Beaumont 3	S08TX071007	NRCS Lab	Chambers	Surge
	S09TX0713097	E2787-E2789		
Beaumont 4	S08TX071012	NRCS Lab	Chambers	Surge
	S09TX0713101	E2772-2775		
Beaumont 5	S08TX071014	E2411-2414	Chambers	Surge
Beaumont 6	S08TX071015	NRCS Lab	Chambers	Surge
	S09TX0713106	E2654-E2655		
Beaumont 7	S08TX071016	NRCS Lab	Chambers	Surge
	S09TX0713107	NRCS Lab		
Beaumont 8	S08TX071019	NRCS Lab	Chambers	Edge
	S09TX0712167	NRCS Lab		
Beaumont 9	S08TX071023	E2395-E2398	Chambers	Edge
Beaumont 10	S08TX071026	NRCS Lab	Chambers	Surge
	S09TX0712162	E2781-E2783		
	S09TX0712353	E3034-E3035		

Appendix A. (continued)

Site ID	Pedon ID	Lab ID	County	Area
Beaumont 11	S08TX071029	NRCS Lab	Chambers	Surge
	S09TX0712163	E3013-E3014		
	S09TX0712357	E3032-E3033		
Beaumont 12	S08TX245003	NRCS Lab	Jefferson	Edge
	S09TX2453111	NRCS Lab		
Beaumont 13	S08TX245004	E2443-E2446	Jefferson	Edge
	S09TX2453105	NRCS Lab		
Beaumont 14	S08TX245007	E2450-E2453	Jefferson	Surge
Beaumont 15	S08TX245010	NRCS Lab	Chambers/Jefferson	Surge
	S09TX0712166	E2794-E2797		
Beaumont 16	S08TX24512	E2427-E2430	Jefferson	Non-Surge
Beaumont 17	S08TX24516	E2423-E2426	Jefferson	Non-Surge
Labelle 1	S08TX245001	E2435-E2438	Jefferson	Edge
	S09TX2453109	E3015		
	S09TX2452367	E2874 and E3036		
Labelle 2	S08TX245006	NRCS Lab	Jefferson	Surge
	S09TX2453116	E2756-E2757		
Labelle 3	S08TX245008	E2454-E2457	Jefferson	Surge
	S09TX2452156	E3030-E3031 and E2780		
	S09TX2452362	E3053-E3054		
	S10TX2452911	E3620-E3623		
Labelle 4	S08TX24510	NRCS Lab	Jefferson	Surge
	S09TX2453115	NRCS Lab		
Labelle 5	S08TX24518	NRCS Lab	Jefferson	Non-Surge
Labelle 6	S08TX24521	NRCS Lab	Jefferson	Surge
	S09TX2452173	E2768-E2769		
	S09TX2452361	E2854-E2855		
Lake Charles 1	S08TX071003	E2387-E2390	Chambers	Non-Surge
Lake Charles 2	S08TX071027	E2407-E2410	Chambers	Surge
League 1	S08TX245002	E2439-E2442	Jefferson	Edge
	S09TX2453110	E2754-E2755		
	S09TX2452368	E2868-E2869		
	S10TX2452913	E3628-E3631		
League 2	S08TX245009	E2458-E2461	Jefferson	Surge

Appendix A. (continued)

Site ID	Pedon ID	Lab ID	County	Area
League 3	S08TX245011	NRCS Lab	Chambers/Jefferson	Surge
	S09TX0712165	NRCS Lab		
League 4	S08TX24511	NRCS Lab	Jefferson	Surge
	S09TX2453114	NRCS Lab		
League 5	S08TX24513	NRCS Lab	Jefferson	Surge
	S09TX2452172	NRCS Lab		
	S09TX2452373	NRCS Lab		
Meaton 1	S08TX24525	NRCS Lab	Jefferson	Surge
	S09TX2452174	E2770-E2771		
	S09TX2342363	E3049-E3050		
Meaton 2	S08TX24527	NRCS Lab	Jefferson	Surge
	S09TX2452170	E3025-E3027		
Morey 1	S08TX071002	E2379-E2382	Chambers	Non-Surge
Morey 2	S08TX071005	NRCS Lab	Chambers	Surge
	S09TX0713095	E2784-E2786		
Morey 3	S08TX071009	NRCS Lab	Chambers	Surge
	S09TX0713099	E3021-E3022		
	S09TX0712359	E3045-E3046		
Morey 4	S08TX071010	NRCS Lab	Chambers	Surge
	S09TX0713102	E3023-E3024		
	S09TX0712360	E3047-E3048		
Morey 5	S08TX071011	NRCS Lab	Chambers	Surge
	S09TX0713100	E2808-E2811		
Morey 6	S08TX071013	NRCS Lab	Chambers	Surge
	S09TX0713103	E2776-E2778		
Morey 7	S08TX071017	NRCS Lab	Chambers	Surge
	S09TX0713108	E2652-E2653		
Morey 8	S08TX071020	E2399-E2402	Chambers	Edge
Morey 9	S08TX071021	NRCS Lab	Chambers	Edge
	S09TX0712159	NRCS Lab		
	S09TX0712369	E2870-E2871		
Morey 10	S08TX071022	NRCS Lab	Chambers	Edge
	S09TX0712158	NRCS Lab		
	S09TX0712372	E2876-E2877		

Appendix A. (continued)

Site ID	Pedon ID	Lab ID	County	Area
Morey 11	S08TX071025	NRCS Lab	Chambers	Surge
	S09TX0712161	E2800 & E3019-E3020		
	S09TX0712352	E3042-E3044		
Morey 12	S08TX071028	NRCS Lab	Chambers	Surge
	S09TX0712164	NRCS Lab		
	S09TX0712356	E2846-E2849		
Morey 13	S08TX071030	E2415-E2418	Chambers	Surge
	S09TX0712155	E3016		
	S09TX0712351	E3037-E3039		
Orcadia 1	S08TX36102	NRCS Lab	Orange	Surge
	S09TX3612168	NRCS Lab		
	S09TX3612354	E3057-E3059		
	S10TX3612910	E3616-E3619		
Orcadia 2	S08TX36103	NRCS Lab	Orange	Surge
	S09TX3612169	E2761-E2762		
	S09TX3612355	E3055-E3056		
	S10TX3612912	E3624-E3627		
Orcadia 3	S08TX36105	NRCS Lab	Orange	Edge
	S09TX3613112	E2759-E2760		
Orcadia 4	S08TX36104	NRCS Lab	Orange	Surge
	S09TX3613113	NRCS Lab		

* NRCS data developed in field office laboratory. All other values from the Soil Characterization Laboratory at Texas A&M University in College Station.

APPENDIX B

SUMMARIZED DATA BY SAMPLE SET

Table B-1. Electrical conductivity of the saturated paste extract (EC_e) and sodium adsorption ratio (SAR) for soils sampled in November 2008

Site ID	Soil Depth (cm)	Strata	EC	SAR
Anahuac 1	0-5	Non-Surge	1.2	4
	5-15		1.4	10
	15-30		2	14
Anahuac 2	0-5	Surge	18.8	27
	5-15		6.3	14
	15-30		1.6	6
	30-50		1	5
Anahuac 3	0-5	Surge	10.4*	
	5-15		18.3*	
	15-50		10.2*	
Anahuac 4	0-5	Edge	2.6	7
	5-15		1.6	4
	15-30		0.9	3
	30-50		0.5	3
Anahuac 5	0-5	Surge	6	13
	5-15		2.9	9
	15-30		0.3	2
Anahuac 6	0-5	Non-Surge	1.7	1
	5-15		0.9	1
	15-30		0.1	1
	30-50		0.2	3
Anahuac 7	0-5	Surge	4.4*	
	5-15		5.9*	
	15-30		3*	
	30-50		4.1*	
Beaumont 1	0-5	Non-Surge	3.9	3
	5-15		3.9	3
	15-30		4.2	4
	30-50		4.1	4
Beaumont 2	0-5	Surge	60*	
	5-15		10.5*	
	15-30		2.5*	
	30-50		2.1*	

Table B-1. (continued)

Site ID	Soil Depth (cm)	Strata	EC	SAR
Beaumont 3	0-5	Surge	34*	
	5-15		14*	
	15-30		6.6*	
	30-50		0.9*	
Beaumont 4	0-5	Surge	29*	
	5-15		15.7*	
	15-30		8.4*	
	30-50		5.5*	
Beaumont 5	0-5	Surge	35.7	29
	5-15		10.2	17
	15-30		14.6	22
	30-50		7	14
Beaumont 6	0-5	Surge	14.4*	
	5-15		8.9*	
	15-30		2*	
	30-50		2*	
Beaumont 7	0-5	Surge	6.9*	
	5-15		3.2*	
	15-30		2.8*	
	30-50		2.4*	
Beaumont 8	0-5	Edge	2.2*	
	5-15		2.2*	
	15-30		2.5*	
	30-50		1.3*	
Beaumont 9	0-5	Edge	29.7	
	5-15		4.2	
	15-30		3.4	
	30-50		2.2	
Beaumont 10	0-5	Surge	48*	
	5-15		10.4*	
	15-30		3.3*	
	30-50		1.3*	
Beaumont 11	0-5	Surge	16.8*	
	5-15		2.6*	
	15-30		1.5*	
	30-50		0.6*	

Table B-1. (continued)

Site ID	Soil Depth (cm)	Strata	EC	SAR
Beaumont 12	0-5	Edge	18.6*	
	5-15		6*	
	15-30		1.5*	
	30-50		0.8*	
Beaumont 13	0-5	Edge	15	20
	5-15		9.1	11
	15-30		3.9	6
	30-50		3	6
Beaumont 14	0-5	Surge	18.3	21
	5-15		5.8	10
	15-30		2.4	5
	30-50		1.3	3
Beaumont 15	0-5	Surge	7.5*	
	5-15		9.6*	
	15-30		6.8*	
	30-50		5.6*	
Beaumont 16	0-5	Non-Surge	0.5	1
	5-15		0.4	2
	15-30		0.4	2
	30-50		0.3	2
Beaumont 17	0-5	Non-Surge	1.1	2
	5-15		1.3	2
	15-30		0.6	2
	30-50		0.5	2
Labelle 1	0-5	Edge	20.4	24
	5-15		6.8	11
	15-30		2.8	5
	30-50		1.8	3
Labelle 2	0-5	Surge	7.9*	
	5-15		7.6*	
	15-30		8.1*	
	30-50		8.1*	
Labelle 3	0-5	Surge	16.5	21
	5-15		4.3	6
	15-30		1.9	3
	30-50		1.3	3

Table B-1. (continued)

Site ID	Soil Depth (cm)	Strata	EC	SAR
Labelle 4	0-5	Surge	6*	
	5-15		2.6*	
	15-30		0.8*	
	30-50		0.6*	
Labelle 5	0-5	Non-Surge	0.3*	
	5-15		0.3*	
	15-30		0.3*	
	30-50		0.3*	
Labelle 6	0-5	Surge	7.8*	
	5-15		4.4*	
	15-30		1.1*	
	30-50		0.7*	
Lake Charles 1	0-5	Non-Surge	3.4	4
	5-15		3.1	3
	15-30		2.4	3
	30-50		2.6	4
Lake Charles 2	0-5	Surge	15.2	22
	5-15		8.1	11
	15-30		3.2	6
	30-50		1.9	6
League 1	0-5	Edge	14	25
	5-15		6.6	12
	15-30		2	2
	30-50		1.3	1
League 2	0-5	Surge	29	34
	5-15		10.9	15
	15-30		2.5	4
	30-50		1.4	4
League 3	0-5	Surge	9.6*	
	5-15		6.4*	
	15-30		3.6*	
	30-50		1.6*	
League 4	0-5	Surge	3.4*	
	5-15		0.7*	
	15-30		0.5*	
	30-50		0.5*	

Table B-1. (continued)

Site ID	Soil Depth (cm)	Strata	EC	SAR
League 5	0-5	Surge	37*	
	5-15		4.5*	
	15-30		0.6*	
	30-50		0.5*	
Meaton 1	0-5	Surge	5.2*	
	5-15		2.8*	
	15-30		1.2*	
	30-50		1.4*	
Meaton 2	0-5	Surge	5*	
	5-15		2.9*	
	15-30		2*	
	30-50		1.8*	
Morey 1	0-5	Non-Surge	1.5	11
	5-15		2.4	20
	15-30		1.6	17
	30-50		1.5	21
Morey 2	0-5	Surge	13.4*	
	5-15		12.4*	
	15-30		4.8*	
	30-50		2.6*	
Morey 3	0-5	Surge	11.8*	
	5-15		4.9*	
	15-30		2.1*	
	30-50		2.5*	
Morey 4	0-5	Surge	12.8*	
	5-15		6.2*	
	15-30		3.8*	
	30-50		3.3*	
Morey 5	0-5	Surge	17.3*	
	5-15		7.6*	
	15-30		7.2*	
	30-50		9.2*	
Morey 6	0-5	Surge	20*	
	5-15		6.7*	
	15-30		4.8*	
	30-50		5.3*	

Table B-1. (continued)

Site ID	Soil Depth (cm)	Strata	EC	SAR
Morey 7	0-5	Surge	15.6*	
	5-15		13.6*	
	15-30		4.2*	
	30-50		2*	
Morey 8	0-5	Edge	1.9	4
	5-15		1.6	2
	15-30		1	1
	30-50		0.5	2
Morey 9	0-5	Edge	1.8*	
	5-15		0.9*	
	15-30		0.6*	
	30-50		0.4*	
Morey 10	0-5	Edge	8*	
	5-15		8*	
	15-30		6.8*	
	30-50		4.5*	
Morey 11	0-5	Surge	15.7*	
	5-15		9.4*	
	15-30		2.9*	
	30-50		1.5	
Morey 12	0-5	Surge	17.2*	
	5-15		3.6*	
	15-30		2.6*	
	30-50		1.2*	
Morey 13	0-5	Surge	3.8	13
	5-15		4.6	12
	15-30		3.5	6
	30-50		2.7	9
Orcadia 1	0-5	Surge	2.7*	
	5-15		1.5*	
	15-30		0.9*	
	30-50		0.8*	
Orcadia 2	0-5	Surge	2.2*	
	5-15		2*	
	15-30		0.8*	
	30-50		1.2*	

Table B-1. (continued)

Site ID	Soil Depth (cm)	Strata	EC	SAR
Orcadia 3	0-5	Surge	2.4*	
	5-15		3*	
	15-30		1.2*	
	30-50		1.3*	
Orcadia 4	0-5	Edge	1*	
	5-15		0.8*	
	15-30		0.7*	
	30-50		0.7*	

* NRCS data developed in field office laboratory. All other values from the Soil Characterization Laboratory at Texas A&M University in College Station.

Table B-2. Electrical conductivity of the saturated paste extract (EC_e) and sodium adsorption ratio (SAR) for soils sampled in April 2009.

Site ID	Soil Depth (cm)	Strata	EC	SAR
Anahuac 2	0-5	Surge	5.9	12
	5-15		5.6	12
	15-30		2.2*	
	30-50		1.8*	
Anahuac 5	0-5	Surge	5.6	11
	5-15		2.5*	
	15-30		0.9*	
	30-50		0.7*	
Anahuac 7	0-5	Surge	23	28
	5-15		7.6	13
	15-30		3.9*	
	30-50		1.4*	
Beaumont 2	0-5	Surge	14	25
	5-15		14	20
	15-30		4.4	15
	30-50		8.9	12
Beaumont 3	0-5	Surge	8.3	19
	5-15		10	18
	15-30		7.3	12
Beaumont 4	0-5	Surge	8.3	12
	5-15		7.1	13
	15-30		5.9	10
	30-50		12	10
Beaumont 6	0-5	Surge	13	15
	5-15		5.6	11
	15-30		3.4*	
	30-50		2.4*	
Beaumont 7	0-5	Surge	4*	
	5-15		3.6*	
Beaumont 8	0-5	Edge	2.8*	
	5-15		3.8*	
	15-30		2.2*	
	30-50		1.8*	
Beaumont 10	0-5	Surge	42	29
	5-15		14	18
	15-30		7.2	11

Table B-2. (continued).

Site ID	Soil Depth (cm)	Strata	EC	SAR
Beaumont 11	0-5	Surge	3.5	8
	5-15		3.1	6
	15-30		2.3*	
	30-50		1.1*	
Beaumont 12	0-5	Edge	3.5*	
	5-15		3.2*	
	15-30		2.3*	
	30-50		1*	
Beaumont 13	0-5	Edge	6.2	12
	5-15		5.4	13
	15-30		4.2	8
	30-50		1.7	
Beaumont 15	0-5	Surge	5.7	11
	5-15		10	15
	15-30		11	14
	30-50		6.8	13
Labelle 1	0-5	Edge	6	11
	5-15		6*	
	15-30		2.5*	
	30-50		1.8*	
Labelle 2	0-5	Surge	6	12
	5-15			
	15-30			
	30-50		5.9	12
Labelle 3	0-5	Surge	13	23
	5-15		1.7	12
	15-30		2.8*	
	30-50		12	20
Labelle 4	0-5	Surge	2.9*	
	5-15		3*	
	15-30		2.7*	
	30-50		3*	
Labelle 6	0-5	Surge	16	18
	5-15		5.7	11
	15-30		1.9*	
	30-50		1.9*	

Table B-2. (continued).

Site ID	Soil Depth (cm)	Strata	EC	SAR
League 1	0-5	Edge	32	22
	5-15		9	10
	15-30		2.5*	
	30-50		3.5*	
League 3	0-5	Surge	2.1*	
	5-15		6.6	8
	15-30		5.1	9
	30-50		4.5*	
League 4	0-5	Surge	2.2*	
	5-15		2.3*	
	15-30		1.7*	
	30-50		2.1*	
League 5	0-5	Surge	3.9*	
	5-15		3.8*	
	15-30		2.8*	
	30-50		2.9*	
Meaton 1	0-5	Surge	7.8	13
	5-15		6.5	13
	15-30		2.3*	
	30-50		2.7*	
Meaton 2	0-5	Surge	34	35
	5-15		17	24
	15-30		6.9	15
	30-50		3.2	8
Morey 2	0-5	Surge	11	15
	5-15		9.1	13
	15-30		6.4	8
	30-50			
Morey 3	0-5	Surge	24	25
	5-15		6.5	13
Morey 4	0-5	Surge	2.8	10
	5-15		3.8	13
	15-30		3.5*	16.6*
	30-50		4.8*	17.7*

Table B-2. (continued).

Site ID	Soil Depth (cm)	Strata	EC	SAR
Morey 5	0-5	Surge	17	19
	5-15		9.3	19
	15-30		11	18
	30-50		8.3	19
Morey 6	0-5	Surge	7.3	17
	5-15		8.9	15
	15-30		13	15
Morey 7	0-5	Surge	28	29
	5-15		12	18
	15-30			
	30-50			
Morey 9	0-5	Edge	1.7*	
	5-15		1.4*	
	15-30		0.7*	
	30-50		0.3*	
Morey 10	0-5	Edge	1.7*	
	5-15		2.5*	
	15-30		2.5*	
	30-50		1.6*	
Morey 11	0-5	Surge	5.4	11
	5-15		5.4	15
	15-30		8.9	11
	30-50		8.6	12
Morey 12	0-5	Surge	2.9*	
	5-15		2.6*	
	15-30		2.8*	
	30-50		2.3*	
Morey 13	0-5	Surge	1.9*	
	5-15		9.8*	
	15-30		3.3	6
	30-50		1.9*	
Orcadia 1	0-5	Surge	1.2*	
	5-15		1.2*	
	15-30		1.1*	
	30-50		0.5*	

Table B-2. (continued)

Site ID	Soil Depth (cm)	Strata	EC	SAR
Orcadia 2	0-5	Surge	11	18
	5-15		7.3	13
	15-30		1.6	
	30-50		2.4	
Orcadia 3	0-5	Surge	15	18
	5-15		9.7	13
	15-30		2.4*	
	30-50		2*	
Orcadia 4	0-5	Edge	0.7*	
	5-15		9.4*	
	15-30		0.3*	
	30-50		0.3*	

* NRCS data developed in field office laboratory. All other values from the Soil Characterization Laboratory at Texas A&M University in College Station.

Table B-3. Electrical conductivity of the saturated paste extract (EC_e) and sodium adsorption ration (SAR) for soils sampled in December 2009.

Site ID	Soil Depth (cm)	Strata	EC	SAR
Anahuac 2	0-5	Surge	0.8	6
	5-15		0.8	8
Anahuac 4	0-5	Edge	0.6	3
	5-15		1.2	3
Anahuac 7	0-5	Surge	1.4	3
	5-15		0.7	6
Beaumont 9	0-5	Edge	0.2	3
	5-15		0.4	4
Beaumont 10	0-5	Surge	15	16
	5-15		12	15
Beaumont 11	0-5	Surge	1.8	3
	5-15		1.5	4
Labelle 1	0-5	Edge	0.6	4
	5-15		1.5	4
Labelle 3	0-5	Surge	2.6	3
	5-15		1	5
Labelle 6	0-5	Surge	4.8	14
	5-15		6.8	15
League 1	0-5	Edge	1.8	13
	5-15		3.5	17
League 5	0-5	Surge	1.5	8
	5-15		1	8
Meaton 1	0-5	Surge	4.5	4
	5-15		2.4	9
Morey 3	0-5	Surge	3.4	6
	5-15		1.9	12
Morey 4	0-5	Surge	12	24
	5-15		20	30
Morey 9	0-5	Edge	0.4	0
	5-15		0.1	1
Morey 10	0-5	Edge	0.3	4
	5-15		0.6	6
Morey 11	0-5	Surge	2	10
	5-15		4.1	14
	15-30		6.7	8

Table B-3. (continued)

Site ID	Soil Depth (cm)	Strata	EC	SAR
Morey 12	0-5	Surge	0.5	5
	5-15		1	7
Morey 13	0-5	Surge	3	4
	5-15		1.2	6
	15-30		2.2	6
Orcadia 1	0-5	Surge	0.8	5
	5-15		0.9	9
	15-30		1.5	8
Orcadia 2	0-5	Surge	3.3	14
	5-15		4	12

Table B-4. Electrical conductivity of the saturated paste extract (EC_e) and sodium adsorption ratio (SAR) for soils sampled in October 2010.

Site ID	Soil Depth (cm)	Strata	EC	SAR
Anahuac 2	0-5	Surge	1	6
	5-15		1	3
	15-30		1	3
	30-50		2	6
Anahuac 4	0-5	Edge	0	3
	5-15		0	5
	15-30		0	5
	30-50		0	4
Beaumont 2	0-5	Surge	2	9
	5-15'		2	9
	15-30		4	11
	30-50		4	10
Labelle 3	0-5	Surge	3	6
	5-15		2	5
	15-30		1	4
	30-50		1	4
League 1	0-5	Edge	1	5
	5-15		1	6
	15-30		2	3
	30-50		2	2
Orcadia 1	0-5	Surge	1	5
	5-15		1	5
	15-30		1	6
	30-50	Surge	1	7
Orcadia 2	0-5		1	8
	5-15		2	8
	15-30		3	12
	30-50		3	14

APPENDIX C

RECORDED RAINFALL DATA

Table C-1. Pre-surge rainfall recorded at the Western Regional Climate Center, Anahuac National Wildlife Refuge gauging station.

Location	Year	Month	Amount (cm)
Anahuac NWR	2008	August	29.21
		September 1-12	7.98

Table C-2. Post surge rainfall recorded at NRCS rain gauges located in Cambers and Jefferson counties. Due to lack of gaging stations following the landfall of Hurricane Ike, no rainfall data is given for September 13-30, 2008.

County	Year	Month	Amount (cm)
Chambers	2008	October	0.5
		November	15.8
		December	6.5
	2009	January	0.5
		February	2.6
		March	8.5
		April	19.8
		May	8.3
		June	2.4
		July	5.3
		August	9.7
		September	7.9
		October	15.2
		November	10.7
		December	16.5
	2010	January	5.7
		February	20.9
		March	3.5
		April	2.4
		May	9.2
		June	5.9
		July	11.9
		August	1.3
		September	11.5
Jefferson	2008	October	0.5
		November	10.1
		December	12.3

Appendix C: Post-Surge Rainfall Totals (continued)

County	Year	Month	Amount (cm)
Jefferson	2009	January	0.4
		February	3.7
		March	11.2
		April	20.9
		May	9.1
		June	4
		July	12.8
		August	9
		September	14.6
		October	15.2
		November	6.5
		December	16.2
	2010	January	6.8
		February	32.9
		March	7.2
		April	0.6
		May	8
		June	17.5
		July	17.8
		August	9.2
		September	9.5

APPENDIX D

SOIL CHARACTERIZATION DATA

November 2008

SOIL CHARACTERIZATION LABORATORY
SOIL AND CROP SCIENCES DEPT., THE TEXAS AGRICULTURAL EXPERIMENT STATION

SOIL SERIES: PEDON NUMBER: 8/17/09
SOIL FAMILY:
LOCATION: Chambers County - NRCS Salinity Study
Non-surge Areas - Anahuac#1, Beaumont #1, Morey #1, Lake Charles #1

		PARTICLE SIZE DISTRIBUTION (mm)												
		SAND						SILT		CLAY				
LAB NO	ID	VC (2.0-1.0)	C (1.0-0.5)	M (0.5-0.25)	F (0.25-0.10)	VF (0.10-0.05)	TOTAL (2.0-0.05)	FINE (0.02-0.002)	TOTAL (0.05-0.002)	FINE (<0.0002)	TOTAL (<0.002)	TEXTURE CLASS	COARSE FRAG-MENTS	ORGN C
		%											%	%
E2376	S08TX071-004-1													
E2377	S08TX071-004-2													
E2378	S08TX071-004-3													
E2379	S08TX071-001-1													
E2380	S08TX071-001-2													
E2381	S08TX071-001-3													
E2382	S08TX071-001-4													
E2383	S08TX071-002-1													
E2384	S08TX071-002-2													
E2385	S08TX071-002-3													
E2386	S08TX071-002-4													
E2387	S08TX071-003-1													
E2388	S08TX071-003-2													
E2389	S08TX071-003-3													
E2390	S08TX071-003-4													

LAB NO	pH (H2O) 1:1	NH4OAc EXTR BASES CA	MG	NA	K	TOTAL	KCl EXTR AL	NaOAc CEC	ECEC	BASE SAT	ESP	SAR	CAL-CITE	DOLO-MITE	CACO3 EQ	GYP SUM
		Meq/100g								%			%			
E2376												4				
E2377												10				
E2378												14				
E2379												3				
E2380												3				
E2381												4				
E2382												4				
E2383												11				
E2384												20				
E2385												17				
E2386												21				
E2387												4				
E2388												3				
E2389												3				
E2390												4				

	SATURATED PASTE EXTRACT									BULK DENSITY			WATER CONTENT	
LAB NO	ELEC COND	H2O CONT	CA	MG	NA	K	HCO3	CL	S04	0.33 BAR	OVEN DRY	COLE	0.33 BAR	15 BAR
	dS/m	%	Meq/l							g/cc		cm/cm	WT%	
E2376	1.2	62	3.1	2.0	6.7	0.1								
E2377	1.4	66	1.6	1.3	12.2	0.0								
E2378	2.0	78	1.2	1.2	15.7	0.0								
E2379	3.9	82	25.5	12.3	12.6	0.4								
E2380	3.9	84	24.0	11.5	14.3	0.4								
E2381	4.2	83	24.0	11.5	16.5	0.3								
E2382	4.1	81	22.5	10.7	17.0	0.3								
E2383	1.5	46	1.8	1.0	13.5	0.1								
E2384	2.4	43	1.7	0.9	22.6	0.0								
E2385	1.6	83	0.7	0.6	13.9	0.0								
E2386	1.5	109	0.5	0.3	13.5	0.0								
E2387	3.4	76	17.5	5.8	12.6	0.2								
E2388	3.1	85	17.0	5.8	10.0	0.2								
E2389	2.4	73	11.5	3.5	7.7	0.1								
E2390	2.6	76	12.5	3.9	10.4	0.2								

Appendix D: November 2008 (continued)

SOIL CHARACTERIZATION LABORATORY

SOIL AND CROP SCIENCES DEPT., THE TEXAS AGRICULTURAL EXPERIMENT STATION

SOIL SERIES: PEDON NUMBER: 8/17/09

SOIL FAMILY: additional data 5/4/11

LOCATION: Chambers County - NRCS Salinity Study

Edge Areas - AnEdge1, BeEdge, Morey #8

				PARTICLE SIZE DISTRIBUTION (mm)												
				----------SAND----------						-------SILT-------		-------CLAY-------				
				VC	C	M	F	VF	TOTAL	FINE	TOTAL	FINE	TOTAL		COARSE	
LAB				(2.0-	(1.0-	(0.5-	(0.25-	(0.10-	(2.0-	(0.02-	(0.05-			TEXTURE	FRAG-	ORGN
NO		ID		1.0)	0.5)	0.25)	0.10)	0.05)	0.05)	0.002)	0.002)	(<0.0002)	(<0.002)	CLASS	MENTS	C
				----------%									----------		%	%
E2391	S08TX071-024-1															
E2392	S08TX071-024-2															
E2393	S08TX071-024-3															
E2394	S08TX071-024-4															
E2395	S08TX071-023-1															
E2396	S08TX071-023-2															
E2397	S08TX071-023-3															
E2398	S08TX071-023-4															
E2399	S08TX071-020-1															
E2400	S08TX071-020-2															
E2401	S08TX071-020-3															
E2402	S08TX071-020-4															

							KCl									
LAB	pH	-------NH4OAc EXTR BASES-------					EXTR	NaOAc		BASE			CAL-	DOLO-	CACO3	GYP
NO	(H2O)	CA	MG	NA	K	TOTAL	AL	CEC	ECEC	SAT	ESP	SAR	CITE	MITE	EQ	SUM
	1:1	----------Meq/100g----------								------%------			----------%----------			
E2391												7				
E2392												4				
E2393												3				
E2394												3				
E2395	5.2	16.1	9.8	18.5	0.6	45.0		38.7		100	16	24				
E2396	6.2	17.0	6.0	4.7	0.3	28.0		37.5		75	8	9				
E2397	6.8	21.0	5.9	1.7	0.3	28.9		38.8		74	2	3				
E2398	6.9	20.8	5.9	1.6	0.3	28.6		38.6		74	3	3				
E2399												4				
E2400												2				
E2401												1				
E2402												2				

	SATURATED PASTE EXTRACT									BULK DENSITY			WATER CONTENT			
LAB	ELEC	H2O								0.33	OVEN		0.33	15		
NO	COND	CONT	CA	MG	NA	K	HCO3	CL	S04	BAR	DRY	COLE	BAR	BAR		
	dS/m	%	----------Meq/l----------							-------g/cc-------		cm/cm	-------WT%-------			
E2391	2.6	58	7.5	2.7	15.2	0.2										
E2392	1.6	48	5.0	1.6	7.6	0.1										
E2393	0.9	46	2.8	0.8	4.6	0.0										
E2394	0.5	63	1.7	0.5	2.7	0.0										
E2395	29.7	65	79.8	49.3	191.3	1.0										
E2396	4.2	70	11.0	3.9	23.9	0.1										
E2397	3.4	73	21.5	6.6	10.9	0.1										
E2398	2.2	72	11.0	3.0	7.4	0.0										
E2399	1.9	61	6.5	2.0	8.3	0.2										
E2400	1.6	54	6.5	1.6	4.5	0.1										
E2401	1.0	54	5.0	1.2	2.5	0.0										
E2402	0.5	56	1.9	0.6	2.2	0.0										

Appendix D: November 2008 (continued)

SOIL CHARACTERIZATION LABORATORY

SOIL AND CROP SCIENCES DEPT., THE TEXAS AGRICULTURAL EXPERIMENT STATION

SOIL SERIES:		PEDON NUMBER:	3/13/09
SOIL FAMILY:			additional data 5/4/11
LOCATION:	Chambers County - NRCS Salinity Study		updated 5/7/12
	Surge Areas - Anahuac#2, LaA Surge#1, Beaumont #5, MoSurge #4		

LAB NO	ID		VC (2.0-1.0)	C (1.0-0.5)	M (0.5-0.25)	F (0.25-0.10)	VF (0.10-0.05)	SAND TOTAL (2.0-0.05)	SILT FINE (0.02-0.002)	SILT TOTAL (0.05-0.002)	CLAY FINE (<0.0002)	CLAY TOTAL (<0.002)	TEXTURE CLASS	COARSE FRAG-MENTS %	ORGN C %
			PARTICLE SIZE DISTRIBUTION (mm) -------%-------												
E2403	S08TX071-0008	0-5													
E2404	S08TX071-0008	5-15													
E2405	S08TX071-0008	u arg													
E2406	S08TX071-0008	50													
E2407	S08TX071-027-1														
E2408	S08TX071-027-2														
E2409	S08TX071-027-3														
E2410	S08TX071-027-4														
E2411	S08TX071-0014	0-5													
E2412	S08TX071-0014	5-15													
E2413	S08TX071-0014	30													
E2414	S08TX071-0014	50													
E2415	S08TX071-030-1														
E2416	S08TX071-030-2														
E2417	S08TX071-030-3														
E2418	S08TX071-030-4														

LAB NO	pH (H2O) 1:1	NH4OAc EXTR BASES CA	MG	NA	K	TOTAL	KCl EXTR AL	NaOAc CEC	ECEC	BASE SAT	ESP	SAR	CAL-CITE	DOLO-MITE	CACO3 EQ	GYP SUM
		Meq/100g								%			%			
E2403	5.1	3.5	3.8	9.2	0.8	17.3	0.0	12.6		100	16	27				
E2404	4.9	3.2	2.2	3.3	0.6	9.3	0.3	10.5		89	14	14				
E2405	4.5	4.6	3.8	1.6	0.4	10.4	6.7	28.0	17.1	37	4	6				
E2406	4.7	6.7	5.5	1.7	0.5	14.4	5.7	32.3	20.1	45	4	5				
E2407												22				
E2408												11				
E2409												6				
E2410												6				
E2411	5.6	13.9	19.1	30.2	1.3	64.5		40.2		100	21	29				
E2412	5.8	11.8	13.6	14.5	0.9	40.8		38.3		100	14	22				
E2413	6.1	12.8	13.5	11.2	0.6	38.1		39.8		96	15	17				
E2414	6.9	16.7	15.2	9.0	0.5	41.4		44.5		93	12	14				
E2415												13				
E2416												12				
E2417												6				
E2418												9				

LAB NO	SATURATED PASTE EXTRACT ELEC COND	H2O CONT	CA	MG	NA	K	HCO3	CL	S04	BULK DENSITY 0.33 BAR	OVEN DRY	COLE	WATER CONTENT 0.33 BAR	15 BAR
	dS/m	%	Meq/l							g/cc		cm/cm	WT%	
E2403	18.8	50	24.0	33.7	143.5	3.2								
E2404	6.3	46	8.5	7.4	40.4	1.5								
E2405	1.6	66	2.3	1.9	8.0	0.2								
E2406	1.0	79	1.3	1.0	5.7	0.1								
E2407	15.2	88	27.4	23.8	108.7	1.2								
E2408	8.1	84	20.0	11.5	44.3	0.4								
E2409	3.2	81	9.5	4.9	15.2	0.2								
E2410	1.9	77	3.9	2.5	11.3	0.1								
E2411	35.7	84	74.9	82.2	256.5	2.1								
E2412	14.6	85	22.5	25.5	108.7	0.9								
E2413	10.2	81	15.0	14.8	66.5	0.4								
E2414	7.0	86	11.5	9.9	44.3	0.1								
E2415	3.8	71	3.7	4.9	27.8	0.7								
E2416	4.6	50	8.0	4.9	30.0	0.2								
E2417	3.5	72	10.0	5.8	16.5	0.1								
E2418	2.7	85	5.5	2.9	17.4	0.1								

Appendix D: November 2008 (continued)

SOIL CHARACTERIZATION LABORATORY

SOIL AND CROP SCIENCES DEPT., THE TEXAS AGRICULTURAL EXPERIMENT STATION

SOIL SERIES: PEDON NUMBER: 8/17/09

SOIL FAMILY:

LOCATION: Jefferson County - NRCS Salinity Study

Non-surge Areas - Anahuac, LaBelle, Beaumont 012 & Beaumont 015

		PARTICLE SIZE DISTRIBUTION (mm)												
		--SAND--						--SILT--		--CLAY--				
LAB NO	ID	VC (2.0-1.0)	C (1.0-0.5)	M (0.5-0.25)	F (0.25-0.10)	VF (0.10-0.05)	TOTAL (2.0-0.05)	FINE (0.02-0.002)	TOTAL (0.05-0.002)	FINE (<0.0002)	TOTAL (<0.002)	TEXTURE CLASS	COARSE FRAG-MENTS	ORGN C
		--%--											%	%
E2419	S08TX245-014-1													
E2420	S08TX245-014-2													
E2421	S08TX245-014-3													
E2422	S08TX245-014-4													
E2423	S08TX245-016-1													
E2424	S08TX245-016-2													
E2425	S08TX245-016-3													
E2426	S08TX245-016-4													
E2427	S08TX245-012-1													
E2428	S08TX245-012-2													
E2429	S08TX245-012-3													
E2430	S08TX245-012-4													
E2431	S08TX245-015-1													
E2432	S08TX245-015-2													
E2433	S08TX245-015-3													
E2434	S08TX245-015-4													

LAB NO	pH (H2O)	--NH4OAc EXTR BASES-- CA	MG	NA	K	TOTAL	KCl EXTR AL	NaOAc CEC	ECEC	BASE SAT	ESP	SAR	CAL-CITE	DOLO-MITE	CACO3 EQ	GYP SUM
	1:1	--Meq/100g--								--%--			--%--			
E2419												1				
E2420												1				
E2421												1				
E2422												3				
E2423												2				
E2424												2				
E2425												2				
E2426												2				
E2427												1				
E2428												2				
E2429												2				
E2430												2				
E2431												1				
E2432												2				
E2433												2				
E2434												3				

	SATURATED PASTE EXTRACT									BULK DENSITY			WATER CONTENT	
LAB NO	ELEC COND	H2O CONT	CA	MG	NA	K	HCO3	CL	S04	0.33 BAR	OVEN DRY	COLE	0.33 BAR	15 BAR
	dS/m	%	--Meq/l--							--g/cc--		cm/cm	--WT%--	
E2419	1.7	44	5.5	2.9	1.8	0.8								
E2420	0.9	40	4.6	0.5	1.4	0.3								
E2421	0.1	29	0.2	0.2	0.6	0.1								
E2422	0.2	31	0.3	0.1	1.3	0.0								
E2423	1.1	51	6.0	1.2	3.2	0.0								
E2424	1.3	50	7.5	1.4	3.7	0.1								
E2425	0.6	52	2.2	0.5	2.5	0.0								
E2426	0.5	57	1.6	0.4	2.2	0.0								
E2427	0.5	61	2.0	0.8	1.6	0.2								
E2428	0.4	59	1.5	0.6	1.5	0.1								
E2429	0.4	71	1.5	0.6	1.6	0.1								
E2430	0.3	73	1.1	0.4	1.3	0.1								
E2431	0.8	65	3.5	1.2	2.0	0.2								
E2432	1.0	65	3.9	1.3	2.7	0.4								
E2433	1.1	62	4.4	1.4	3.9	0.2								
E2434	1.1	66	3.5	1.1	4.4	0.1								

Appendix D: November 2008 (continued)

SOIL CHARACTERIZATION LABORATORY

SOIL AND CROP SCIENCES DEPT., THE TEXAS AGRICULTURAL EXPERIMENT STATION

SOIL SERIES: PEDON NUMBER: 8/17/09

SOIL FAMILY: additional data 5/4/11

LOCATION: Jefferson County - NRCS Salinity Study

Edge Areas - LaBelle#1, League#1, Beaumont#10

LAB NO	ID		VC (2.0-1.0)	C (1.0-0.5)	M (0.5-0.25)	F (0.25-0.10)	VF (0.10-0.05)	SAND TOTAL (2.0-0.05)	SILT FINE (0.02-0.002)	SILT TOTAL (0.05-0.002)	CLAY FINE (<0.0002)	CLAY TOTAL (<0.002)	TEXTURE CLASS	COARSE FRAG-MENTS %	ORGN C %
			PARTICLE SIZE DISTRIBUTION (mm) ----------%----------												
E2435	S08TX245-001-1														
E2436	S08TX245-001-2														
E2437	S08TX245-001-3														
E2438	S08TX245-001-4														
E2439	S08TX245-0002	0-5													
E2440	S08TX245-0002	5-15													
E2441	S08TX245-0002	30													
E2442	S08TX245-0002	50													
E2443	S08TX245-0004	0-5													
E2444	S08TX245-0004	5-15													
E2445	S08TX245-0004	30													
E2446	S08TX245-0004	50													

LAB NO	pH (H2O) 1:1	CA	MG	NA	K	TOTAL	KCl EXTR AL	NaOAc CEC	ECEC	BASE SAT	ESP	SAR	CAL-CITE	DOLO-MITE	CACO3 EQ	GYP SUM
		-------NH4OAc EXTR BASES------- Meq/100g								----%----			----%----			
E2435												24				
E2436												11				
E2437												5				
E2438												3				
E2439	5.4	9.6	7.9	13.6	0.6	31.7		31.8		100	20	25				
E2440	5.9	13.1	7.9	6.4	0.3	27.7		31.2		89	12	12				
E2441	6.5	14.1	5.8	1.0	0.2	21.1		28.3		75	2	2				
E2442	6.6	10.7	3.9	0.5	0.2	15.3		19.5		78	2	1				
E2443	5.1	23.4	13.1	15.5	1.0	53.0		48.9		100	11	20				
E2444	5.4	25.9	9.3	8.3	0.3	43.8		44.6		98	10	11				
E2445	6.5	25.0	7.5	3.6	0.3	36.4		40.3		90	5	6				
E2446	6.8	23.5	5.7	3.4	0.3	32.9		37.9		87	6	6				

LAB NO	ELEC COND dS/m	H2O CONT %	CA	MG	NA	K	HCO3	CL	S04	BULK DENSITY 0.33 BAR	BULK DENSITY OVEN DRY	COLE cm/cm	WATER CONTENT 0.33 BAR	WATER CONTENT 15 BAR		
	SATURATED PASTE EXTRACT		------Meq/l------							----g/cc----			----WT%----			
E2435	20.4	65	38.9	35.4	143.5	1.2										
E2436	6.8	64	15.5	9.0	40.0	0.3										
E2437	2.8	66	10.5	4.9	13.5	0.1										
E2438	1.8	67	6.5	3.1	6.3	0.1										
E2439	14.0	67	19.5	18.1	108.7	0.5										
E2440	6.6	65	14.0	8.2	40.0	0.1										
E2441	2.0	63	10.0	4.1	5.6	0.0										
E2442	1.3	56	8.0	2.6	3.0	0.0										
E2443	15.0	96	30.9	23.8	104.3	1.0										
E2444	9.1	79	25.5	12.3	49.6	0.2										
E2445	3.9	74	13.5	4.9	19.1	0.1										
E2446	3.0	71	9.5	3.2	16.1	0.1										

Appendix D: November 2008 (continued)

SOIL CHARACTERIZATION LABORATORY

SOIL AND CROP SCIENCES DEPT., THE TEXAS AGRICULTURAL EXPERIMENT STATION

SOIL SERIES: PEDON NUMBER: 3/30/09

SOIL FAMILY: additional data 5/4/11

LOCATION: Jefferson County - NRCS Salinity Study

Surge Areas - Anahuac#4, BmA Surge#1, LaA Surge#1, LtA Surge#1

			PARTICLE SIZE DISTRIBUTION (mm)												
			----------SAND----------						-------SILT-------		-------CLAY-------				
			VC	C	M	F	VF	TOTAL	FINE	TOTAL	FINE	TOTAL		COARSE	
LAB			(2.0-	(1.0-	(0.5-	(0.25-	(0.10-	(2.0-	(0.02-	(0.05-			TEXTURE	FRAG-	ORGN
NO	ID		1.0)	0.5)	0.25)	0.10)	0.05)	0.05)	0.002)	0.002)	(<0.0002)	(<0.002)	CLASS	MENTS	C
			---------------%											%	%
E2447	S08TX245-005-1														
E2448	S08TX245-005-2														
E2449	S08TX245-005-3														
E2450	S08TX245-007-1														
E2451	S08TX245-007-2														
E2452	S08TX245-007-3														
E2453	S08TX245-007-4														
E2454	S08TX245-0008	0-5													
E2455	S08TX245-0008	5-15													
E2456	S08TX245-0008	u arg													
E2457	S08TX245-0008	50													
E2458	S08TX245-0009	0-5													
E2459	S08TX245-0009	5-15													
E2460	S08TX245-0009	30													
E2461	S08TX245-0009	50													

							KCl									
LAB	pH	----NH4OAc EXTR BASES----					EXTR	NaOAc		BASE			CAL-	DOLO-	CACO3	GYP
NO	(H2O)	CA	MG	NA	K	TOTAL	AL	CEC	ECEC	SAT	ESP	SAR	CITE	MITE	EQ	SUM
	1:1	----------Meq/100g----------								---------%---------			----------%----------			
E2447												13				
E2448												9				
E2449												2				
E2450												21				
E2451												10				
E2452												5				
E2453												3				
E2454	6.5	12.9	5.8	9.5	0.4	28.6		23.5		100	10	21				
E2455	7.4	15.2	3.3	2.4	0.2	21.1		23.9		88	5	6				
E2456	7.6	19.1	3.7	1.1	0.2	24.1		29.1		83	2	3				
E2457	7.7	14.9	3.0	0.9	0.2	19.0		22.7		84	3	3				
E2458	5.3	15.7	15.4	32.3	1.5	64.9		47.3		100	21	34				
E2459	5.1	16.2	7.7	9.1	0.5	33.5		38.5		87	11	15				
E2460	5.6	20.8	7.9	2.0	0.2	30.9		39.5		78	3	4				
E2461	6.3	13.6	5.8	1.6	0.2	21.2		26.4		80	4	4				

	SATURATED PASTE EXTRACT									BULK DENSITY			WATER CONTENT	
LAB	ELEC	H2O								0.33	OVEN		0.33	15
NO	COND	CONT	CA	MG	NA	K	HCO3	CL	S04	BAR	DRY	COLE	BAR	BAR
	dS/m	%	----------Meq/l----------							--------g/cc-------		cm/cm	-------WT%-------	
E2447	6.0	73	9.0	8.2	37.0	1.5								
E2448	2.9	57	6.5	2.2	17.8	0.4								
E2449	0.3	47	0.8	0.2	1.3	0.1								
E2450	18.3	112	39.9	41.1	134.8	2.0								
E2451	5.8	73	15.5	8.2	33.0	0.2								
E2452	2.4	72	8.5	4.0	11.3	0.1								
E2453	1.3	72	3.8	1.7	5.7	0.0								
E2454	16.5	62	42.4	22.2	117.4	0.7								
E2455	4.3	57	17.5	4.9	20.0	0.1								
E2456	1.9	63	9.5	2.2	6.5	0.0								
E2457	1.3	62	5.5	1.2	5.0	0.0								
E2458	29.0	99	41.9	49.3	226.1	2.5								
E2459	10.9	76	24.5	15.6	64.8	0.3								
E2460	2.5	73	9.0	4.1	11.3	0.0								
E2461	1.4	67	4.5	1.9	7.2	0.0								

Appendix D: April 2009

SOIL CHARACTERIZATION LABORATORY
SOIL AND CROP SCIENCES DEPT., THE TEXAS AGRICULTURAL EXPERIMENT STATION

SOIL SERIES:										PEDON NUMBER:						6/15/09
SOIL FAMILY:																pg 1
LOCATION:		NRCS water soluble extracts														
				PARTICLE SIZE DISTRIBUTION (mm)												
				---SAND---						---SILT---		---CLAY---				
				VC	C	M	F	VF	TOTAL	FINE	TOTAL	FINE	TOTAL		COARSE	
LAB				(2.0-	(1.0-	(0.5-	(0.25-	(0.10-	(2.0-	(0.02-	(0.05-			TEXTURE	FRAG-	ORGN
NO		ID		1.0)	0.5)	0.25)	0.10)	0.05)	0.05)	0.002)	0.002)	(<0.0002)	(<0.002)	CLASS	MENTS	C
				---%---											%	%
E2635	3Q	S09TX409-4014	Bt													
E2636	5S	S09TX409-4014	Btk2													
E2637	5Q	S09TX409-4014	Bky2													
E2638	1L	S09TX025-2088	Bk3													
E2639	19	S09TX409-4001	Ap													
E2640	21	S09TX409-4001	Bk1													
E2641	22	S09TX409-4001	Bk2													
E2642	23	S09TX409-4002	Ap													
E2643	25	S09TX409-4002	Bw1													
E2644	101	S09TX409-4002	Bk1													
E2645	3Ct	S09TX025-2066	Ap													
E2646	3dt	S09TX025-2066	Bw1													
E2647	3lt	S09TX025-2066	Bk2													
E2648	3S	Surface 1														

							KCl									
LAB	pH	---NH4OAc EXTR BASES---					EXTR	NaOAc		BASE			CAL-	DOLO-	CACO3	GYP
NO	(H2O)	CA	MG	NA	K	TOTAL	AL	CEC	ECEC	SAT	ESP	SAR	CITE	MITE	EQ	SUM
	1:1	---Meq/100g---								---%---			---%---			
E2635												4				
E2636												21				
E2637												12				
E2638												13				
E2639												6				
E2640												9				
E2641												9				
E2642												1				
E2643												2				
E2644												3				
E2645												2				
E2646												7				
E2647												14				
E2648												15				

	SATURATED PASTE EXTRACT									BULK DENSITY			WATER CONTENT			
LAB	ELEC	H2O								0.33	OVEN		0.33	15		
NO	COND	CONT	CA	MG	NA	K	HCO3	CL	S04	BAR	DRY	COLE	BAR	BAR		
	dS/m	%	---Meq/l---							---g/cc---		cm/cm	---WT%---			
E2635	0.6	59	1.3	0.4	3.6	0.0										
E2636	1.4	71	0.7	0.4	15.2	0.0										
E2637	5.4	67	15.0	5.8	40.0	0.2										
E2638	5.5	86	16.5	4.9	42.2	0.2										
E2639	4.4	65	19.5	2.3	19.1	0.3										
E2640	3.7	80	10.0	2.5	22.2	0.2										
E2641	5.4	29	23.0	4.9	32.2	0.3										
E2642	1.1	65	6.0	0.9	2.3	0.2										
E2643	0.6	73	2.6	0.4	2.3	0.1										
E2644	1.1	79	4.0	1.2	4.7	0.1										
E2645	0.7	72	3.7	0.5	2.4	0.2										
E2646	0.5	64	0.6	0.2	4.3	0.0										
E2647	5.5	71	17.0	2.6	42.2	0.2										
E2648	10.4	74	16.0	17.3	62.6	0.6										

Appendix D: April 2009 (continued)

SOIL CHARACTERIZATION LABORATORY

SOIL AND CROP SCIENCES DEPT., THE TEXAS AGRICULTURAL EXPERIMENT STATION

SOIL SERIES: PEDON NUMBER: 6/15/09

SOIL FAMILY: pg 2

LOCATION: NRCS water soluble extracts

LAB NO				PARTICLE SIZE DISTRIBUTION (mm) ---SAND--- VC (2.0-1.0)	C (1.0-0.5)	M (0.5-0.25)	F (0.25-0.10)	VF (0.10-0.05)	TOTAL (2.0-0.05)	---SILT--- FINE (0.02-0.002)	TOTAL (0.05-0.002)	---CLAY--- FINE (<0.0002)	TOTAL (<0.002)	TEXTURE CLASS	COARSE FRAG-MENTS %	ORGN C %
				---%									---%			
E2649	4L	Surface 2														
E2650	4M	Surface 3														
E2651	4P	Surface 4														
E2652	1M	S09TX071-3108	0-5													
E2653	1Q	S09TX071-3108	5-15													
E2654	2K	S09TX071-3106	0-5													
E2655	2S	S09TX071-3106	5-15													

LAB NO	pH (H2O) 1:1	---NH4OAc EXTR BASES--- CA	MG	NA	K	TOTAL	KCl EXTR AL	NaOAc CEC	ECEC	BASE SAT	ESP	SAR	CAL-CITE	DOLO-MITE	CACO3 EQ	GYP SUM
		---Meq/100g---								---%---			---%---			
E2649												15				
E2650												18				
E2651												16				
E2652												29				
E2653												18				
E2654												15				
E2655												11				

LAB NO	SATURATED PASTE EXTRACT ELEC COND dS/m	H2O CONT %	CA	MG	NA	K	HCO3	CL	S04	BULK DENSITY 0.33 BAR	OVEN DRY	COLE cm/cm	WATER CONTENT 0.33 BAR	15 BAR		
			---Meq/l---							---g/cc---			---WT%---			
E2649	9.0	62	13.0	15.6	55.2	0.6										
E2650	16.0	86	31.9	33.7	104.3	1.3										
E2651	14.2	79	26.9	26.3	83.5	0.8										
E2652	28.2	60	34.9	65.8	204.3	1.9										
E2653	12.0	58	17.5	18.1	75.7	0.6										
E2654	12.8	88	21.0	26.3	71.7	0.9										
E2655	5.6	72	9.0	9.9	32.2	0.2										

Appendix D: April 2009 (continued)

SOIL CHARACTERIZATION LABORATORY

SOIL AND CROP SCIENCES DEPT., THE TEXAS AGRICULTURAL EXPERIMENT STATION

SOIL SERIES:		PEDON NUMBER:	8/31/09
SOIL FAMILY:			pg 1
LOCATION:	NRCS water soluble extracts		

				PARTICLE SIZE DISTRIBUTION (mm)												
				---SAND---						---SILT---		---CLAY---				
				VC	C	M	F	VF	TOTAL	FINE	TOTAL	FINE	TOTAL		COARSE	
LAB				(2.0-	(1.0-	(0.5-	(0.25-	(0.10-	(2.0-	(0.02-	(0.05-			TEXTURE	FRAG-	ORGN
NO		ID		1.0)	0.5)	0.25)	0.10)	0.05)	0.05)	0.002)	0.002)	(<0.0002)	(<0.002)	CLASS	MENTS	C
				---%---											%	%
E2717	5f	S09TX409-8125		Btk2	78-102											
E2718	5P	S09TX025-2177		Bk2	116-170											
E2719	113	S09TX025-2177		Bky	170-203											
E2720	4H	S09TX409-3126		Bssk2	58-85											
E2721	5M	S09TX409-3126		Bssk3	85-153											
E2722	1R	S09TX409-3126		Bssk4	153-200											
E2723	4C	S09TX409-2184		A	0-10											
E2724	5K	S09TX409-2184		Bk2	71-105											
E2725	125	S09TX409-2184		2C	128-180											
E2726	2R	S09TX409-2180		Bkyz3	195-220											
E2727	1S	S09TX409-2090		Bss4	161-221											
E2728	3L	S09TX071-3096			0-5 cm											
E2729	3P	S09TX071-3096			5-15 cm											
E2730	4f	S09TX071-3096			15-30 cm											

							KCl									
LAB	pH	---NH4OAc EXTR BASES---					EXTR	NaOAc		BASE			CAL-	DOLO-	CACO3	GYP
NO	(H2O)	CA	MG	NA	K	TOTAL	AL	CEC	ECEC	SAT	ESP	SAR	CITE	MITE	EQ	SUM
	1:1	---Meq/100g---								---%---			---%---			
E2717												17				
E2718												9				
E2719												9				
E2720												38				
E2721												51				
E2722												51				
E2723												4				
E2724												53				
E2725												56				
E2726												8				
E2727												9				
E2728												25				
E2729												20				
E2730												15				

	SATURATED PASTE EXTRACT									BULK DENSITY			WATER CONTENT			
LAB	ELEC	H2O								0.33	OVEN		0.33	15		
NO	COND	CONT	CA	MG	NA	K	HCO3	CL	S04	BAR	DRY	COLE	BAR	BAR		
	dS/m	%	---Meq/l---							---g/cc---		cm/cm	---WT%---			
E2717	4.5	53	4.8	3.9	35.7	0.1										
E2718	4.7	57	18.0	4.9	31.7	0.3										
E2719	4.8	61	19.5	4.9	32.2	0.3										
E2720	5.3	99	1.2	1.5	44.3	0.4										
E2721	11.1	74	2.0	5.8	100.0	0.7										
E2722	13.9	66	3.2	9.0	126.1	0.9										
E2723	1.3	75	4.6	1.2	6.0	0.6										
E2724	6.9	77	0.8	1.6	57.8	0.5										
E2725	13.1	47	2.2	7.4	121.7	0.9										
E2726	4.7	26	19.0	7.4	30.0	0.3										
E2727	5.4	75	15.5	11.5	31.3	0.2										
E2728	14.4	18	14.5	28.0	113.0	1.5										
E2729	14.0	102	19.5	25.5	95.7	0.9										
E2730	4.4	22	4.5	4.1	30.9	0.3										

Appendix D: April 2009 (continued)

SOIL CHARACTERIZATION LABORATORY																
SOIL AND CROP SCIENCES DEPT., THE TEXAS AGRICULTURAL EXPERIMENT STATION																
SOIL SERIES:										PEDON NUMBER:						8/31/09
SOIL FAMILY:																pg 2
LOCATION:		NRCS water soluble extracts														
				PARTICLE SIZE DISTRIBUTION (mm)												
				---------------------------SAND--------------------------						-------SILT-------		-------CLAY-------				
				VC	C	M	F	VF	TOTAL	FINE	TOTAL	FINE	TOTAL		COARSE	
LAB				(2.0-	(1.0-	(0.5-	(0.25-	(0.10-	(2.0-	(0.02-	(0.05-			TEXTURE	FRAG-	ORGN
NO				1.0)	0.5)	0.25)	0.10)	0.05)	0.05)	0.002)	0.002)	(<0.0002)	(<0.002)	CLASS	MENTS	C
				--%									---		%	%
E2731	1N	S09TX071-3096			30-50 cm											
E2732	1K	S09TX409-2181		Bk1	Bk1											
E2733	4N	S09TX409-2188		Bt2	73-90											
E2734	3gt	S09TX409-2188		Btk2	90-130											
E2735	4	S09TX409-2189		Bky	179-210											
E2736	2Q	S09TX245-3104			0-5 cm											
E2737	4R	S09TX245-3105			0-5 cm											
E2738	5L	S09TX245-3105			5-15 cm											
E2739	3N	S09TX245-3105			15-30 cm											

							KCl									
LAB	pH	-------------NH4OAc EXTR BASES-------------					EXTR	NaOAc		BASE			CAL-	DOLO-	CACO3	GYP
NO	(H2O)	CA	MG	NA	K	TOTAL	AL	CEC	ECEC	SAT	ESP	SAR	CITE	MITE	EQ	SUM
	1:1	-----------------------------------Meq/100g---------------------------------------								---------%----------			-----------------------%----------------------			
E2731												12				
E2732												23				
E2733												8				
E2734												9				
E2735												17				
E2736												11				
E2737												12				
E2738												13				
E2739												8				

	SATURATED PASTE EXTRACT									BULK DENSITY			WATER CONTENT			
LAB	ELEC	H2O								0.33	OVEN		0.33	15		
NO	COND	CONT	CA	MG	NA	K	HCO3	CL	S04	BAR	DRY	COLE	BAR	BAR		
	dS/m	%	----------------------------------Meq/l-----------------------------------							--------g/cc-------		cm/cm	-------WT%-------			
E2731	8.9	19	16.5	18.1	48.7	0.2										
E2732	4.8	38	4.5	1.5	39.1	0.2										
E2733	4.3	66	15.5	4.9	25.7	0.1										
E2734	4.5	73	15.5	5.8	28.7	0.2										
E2735	7.7	34	17.5	8.2	60.0	0.3										
E2736	5.6	15	9.5	7.4	33.0	1.1										
E2737	6.2	41	12.0	8.2	36.5	0.6										
E2738	5.4	35	10.0	4.9	34.3	0.3										
E2739	4.2	38	11.0	4.1	22.2	0.1										

Appendix D: April 2009 (continued)

SOIL CHARACTERIZATION LABORATORY

SOIL AND CROP SCIENCES DEPT., THE TEXAS AGRICULTURAL EXPERIMENT STATION

SOIL SERIES:										PEDON NUMBER:						01/12/10
SOIL FAMILY:																pg 1
LOCATION:		NRCS water soluble extracts (10/09)														

				PARTICLE SIZE DISTRIBUTION (mm)												
				----SAND----						-------SILT-------		-------CLAY-------				
				VC	C	M	F	VF	TOTAL	FINE	TOTAL	FINE	TOTAL		COARSE	
LAB				(2.0-	(1.0-	(0.5-	(0.25-	(0.10-	(2.0-	(0.02-	(0.05-			TEXTURE	FRAG-	ORGN
NO		ID		1.0)	0.5)	0.25)	0.10)	0.05)	0.05)	0.002)	0.002)	(<0.0002)	(<0.002)	CLASS	MENTS	C
				----%									----		%	%
E2753	1	S09TX245-3109		0-5												
E2754	2L	S09TX245-3110		0-5												
E2755	3K	S09TX245-3110		5-15												
E2756	5J	S09TX245-3116		0-5												
E2757	131	S09TX245-3116		30-50												
E2758	1C	Sabine Ranch #1														
E2759	4G	S09TX361-3113		0-5												
E2760	4S	S09TX361-3113		5-15												
E2761	4K	S09TX361-2169		0-5												
E2762	5	S09TX361-2169		5-15												
E2763	6	S09TX245-2170		0-5												
E2764	5N	S09TX245-2170		5-15												
E2765	7	S09TX245-2170		15-30												
E2766	112	P09TX245-2171		0-5												
E2767	126	P09TX245-2171		5-15												

							KCl									
LAB	pH	----NH4OAc EXTR BASES----					EXTR	NaOAc		BASE			CAL-	DOLO-	CACO3	GYP
NO	(H2O)	CA	MG	NA	K	TOTAL	AL	CEC	ECEC	SAT	ESP	SAR	CITE	MITE	EQ	SUM
	1:1	----Meq/100g----								----%----			----%----			
E2753												12				
E2754												22				
E2755												10				
E2756												12				
E2757												12				
E2758												22				
E2759												18				
E2760												13				
E2761												18				
E2762												13				
E2763												35				
E2764												24				
E2765												16				
E2766												35				
E2767												15				

	SATURATED PASTE EXTRACT									BULK DENSITY			WATER CONTENT			
LAB	ELEC	H2O								0.33	OVEN		0.33	15		
NO	COND	CONT	CA	MG	NA	K	HCO3	CL	S04	BAR	DRY	COLE	BAR	BAR		
	dS/m	%	----Meq/l----							----g/cc----		cm/cm	----WT%----			
E2753	5.3	38	9.0	6.6	32.2	0.4										
E2754	32.4	35	89.8	65.8	191.3	0.8										
E2755	9.0	41	24.5	14.8	45.7	0.1										
E2756	6.0	81	10.0	9.9	37.8	0.9										
E2757	5.9	70	10.5	7.4	34.8	0.2										
E2758	18.0	49	36.4	23.0	117.4	2.9										
E2759	14.5	70	32.9	25.5	95.7	0.3										
E2760	9.7	59	22.5	16.4	59.1	0.1										
E2761	11.4	39	12.0	21.4	73.5	1.2										
E2762	7.3	28	9.0	14.0	44.8	0.8										
E2763	40.8	38	45.4	98.7	295.7	2.8										
E2764	19.0	34	21.5	36.2	130.4	1.3										
E2765	8.0	29	9.5	12.3	52.2	0.2										
E2766	42.7	56	79.8	74.0	304.3	6.9										
E2767	10.3	20	17.5	14.0	61.3	1.3										

Appendix D: April 2009 (continued)

SOIL CHARACTERIZATION LABORATORY

SOIL AND CROP SCIENCES DEPT., THE TEXAS AGRICULTURAL EXPERIMENT STATION

SOIL SERIES: PEDON NUMBER: 01/12/10

SOIL FAMILY: pg 2

LOCATION: NRCS water soluble extracts (10/09)

				PARTICLE SIZE DISTRIBUTION (mm)												
				---SAND---						---SILT---		---CLAY---				
				VC	C	M	F	VF	TOTAL	FINE	TOTAL	FINE	TOTAL		COARSE	
LAB				(2.0-	(1.0-	(0.5-	(0.25-	(0.10-	(2.0-	(0.02-	(0.05-			TEXTURE	FRAG-	ORGN
NO		ID		1.0)	0.5)	0.25)	0.10)	0.05)	0.05)	0.002)	0.002)	(<0.0002)	(<0.002)	CLASS	MENTS	C
				---%---											%	%
E2768	3G	S09TX245-2173		0-5												
E2769	4J	S09TX245-2173		5-15												
E2770	5H	S09TX245-2174		0-5												
E2771	5R	S09TX245-2174		5-15												
E2772	5G	S09TX071-3101		0-5												
E2773	2P	S09TX071-3101		5-15												
E2774	3R	S09TX071-3101		15-30												
E2775	5 i	S09TX071-3101		30-50												
E2776	13	S09TX071-3103		0-5												
E2777	26	S09TX071-3103		5-15												
E2778	127	S09TX071-3103		15-30												
E2779	3	S09TX245-2156		0-5												
E2780	1P	S09TX245-2156		30-50												
E2781	128	S09TX071-2162		0-5												
E2782	129	S09TX071-2162		5-15												

							KCl									
LAB	pH	---NH4OAc EXTR BASES---					EXTR	NaOAc		BASE			CAL-	DOLO-	CACO3	GYP
NO	(H2O)	CA	MG	NA	K	TOTAL	AL	CEC	ECEC	SAT	ESP	SAR	CITE	MITE	EQ	SUM
	1:1	---Meq/100g---								---%---			---%---			
E2768												18				
E2769												11				
E2770												13				
E2771												13				
E2772												12				
E2773												13				
E2774												10				
E2775												10				
E2776												17				
E2777												15				
E2778												15				
E2779												25				
E2780												20				
E2781												29				
E2782												18				

	SATURATED PASTE EXTRACT									BULK DENSITY			WATER CONTENT			
LAB	ELEC	H2O								0.33	OVEN		0.33	15		
NO	COND	CONT	CA	MG	NA	K	HCO3	CL	S04	BAR	DRY	COLE	BAR	BAR		
	dS/m	%	---Meq/l---							---g/cc---		cm/cm	---WT%---			
E2768	16.0	33	35.9	25.5	100.0	1.6										
E2769	5.7	30	13.5	5.8	33.0	0.3										
E2770	7.8	57	11.5	14.8	47.4	1.0										
E2771	6.5	53	9.5	10.7	40.4	0.7										
E2772	8.3	54	16.5	18.9	48.7	0.7										
E2773	7.1	50	12.0	13.2	44.3	0.3										
E2774	5.9	50	11.5	12.3	33.0	0.2										
E2775	12.0	48	29.9	32.9	57.0	0.2										
E2776	7.3	33	11.0	7.4	50.9	0.9										
E2777	8.9	34	20.0	8.2	56.1	0.4										
E2778	12.8	32	37.9	13.2	73.9	0.3										
E2779	15.7	33	23.5	18.9	113.0	0.8										
E2780	11.9	28	20.0	12.3	81.7	0.2										
E2781	42.3	68	89.8	106.9	287.0	3.1										
E2782	14.0	39	24.5	20.6	87.4	1.3										

Appendix D: April 2009 (continued)

SOIL CHARACTERIZATION LABORATORY

SOIL AND CROP SCIENCES DEPT., THE TEXAS AGRICULTURAL EXPERIMENT STATION

SOIL SERIES: PEDON NUMBER: 01/12/10

SOIL FAMILY: pg 3

LOCATION: NRCS water soluble extracts (10/09)

				PARTICLE SIZE DISTRIBUTION (mm)												
				----SAND----						---SILT---		---CLAY---				
				VC	C	M	F	VF	TOTAL	FINE	TOTAL	FINE	TOTAL		COARSE	
LAB				(2.0-	(1.0-	(0.5-	(0.25-	(0.10-	(2.0-	(0.02-	(0.05-			TEXTURE	FRAG-	ORGN
NO		ID		1.0)	0.5)	0.25)	0.10)	0.05)	0.05)	0.002)	0.002)	(<0.0002)	(<0.002)	CLASS	MENTS	C
				-----%									-----%		%	%
E2783	130	S09TX071-2162		15-30												
E2784	2	S09TX071-3095		0-5												
E2785	3M	S09TX071-3095		5-15												
E2786	4Q	S09TX071-3095		15-30												
E2787	8	S09TX071-3097		0-5												
E2788	17	S09TX071-3097		5-15												
E2789	15	S09TX071-3097		15-30												
E2790	24	S09TX071-3098		0-5												
E2791	14	S09TX071-3098		5-15												
E2792	1H	S09TX071-3099		0-5												
E2793	25	S09TX071-3099		5-15												
E2794	138	S09TX071-2166		0-5												
E2795	142	S09TX071-2166		5-15												
E2796	143	S09TX071-2166		15-30												
E2797	144	S09TX071-2166		30-50												

							KCl									
LAB	pH	----NH4OAc EXTR BASES----					EXTR	NaOAc		BASE			CAL-	DOLO-	CACO3	GYP
NO	(H2O)	CA	MG	NA	K	TOTAL	AL	CEC	ECEC	SAT	ESP	SAR	CITE	MITE	EQ	SUM
	1:1	----Meq/100g----								---%---			---%---			
E2783												11				
E2784												15				
E2785												13				
E2786												8				
E2787												19				
E2788												18				
E2789												12				
E2790												13				
E2791												13				
E2792												26				
E2793												11				
E2794												11				
E2795												15				
E2796												14				
E2797												13				

	SATURATED PASTE EXTRACT									BULK DENSITY			WATER CONTENT	
LAB	ELEC	H2O								0.33	OVEN		0.33	15
NO	COND	CONT	CA	MG	NA	K	HCO3	CL	S04	BAR	DRY	COLE	BAR	BAR
	dS/m	%	----Meq/l----							---g/cc---		cm/cm	---WT%---	
E2783	7.2	66	16.0	10.7	39.1	0.4								
E2784	11.0	41	19.0	23.0	66.5	1.3								
E2785	9.1	39	17.0	16.4	51.3	0.8								
E2786	6.4	37	15.5	14.0	30.0	0.2								
E2787	8.3	54	8.0	11.5	58.7	1.2								
E2788	10.2		14.5	15.6	68.3	0.8								
E2789	7.3	52	14.0	12.3	43.5	0.3								
E2790	6.8	38	9.5	10.7	41.7	1.1								
E2791	11.0	32	41.4	16.4	68.3	1.5								
E2792	30.5	49	64.9	49.3	195.7	4.8								
E2793	6.4	38	14.5	7.4	37.8	1.3								
E2794	5.7	42	10.0	10.7	36.5	1.0								
E2795	10.1	42	17.0	18.1	63.9	0.7								
E2796	10.7	40	19.0	23.8	63.9	0.6								
E2797	6.8	36	9.0	13.2	42.6	0.2								

Appendix D: April 2009 (continued)

SOIL CHARACTERIZATION LABORATORY
SOIL AND CROP SCIENCES DEPT., THE TEXAS AGRICULTURAL EXPERIMENT STATION

SOIL SERIES:		PEDON NUMBER:	01/12/10
SOIL FAMILY:			pg 4
LOCATION:	NRCS water soluble extracts (10/09)		

				PARTICLE SIZE DISTRIBUTION (mm)												
				----------SAND----------						-------SILT-------		-------CLAY-------				
				VC	C	M	F	VF	TOTAL	FINE	TOTAL	FINE	TOTAL		COARSE	
LAB				(2.0-	(1.0-	(0.5-	(0.25-	(0.10-	(2.0-	(0.02-	(0.05-			TEXTURE	FRAG-	ORGN
NO		ID		1.0)	0.5)	0.25)	0.10)	0.05)	0.05)	0.002)	0.002)	(<0.0002)	(<0.002)	CLASS	MENTS	C
				----------------%									----------------		%	%
E2798	4 i	S09TX071-2155	15-30													
E2799	139	S09TX071-2161	5-15													
E2800	140	S09TX071-2161	upper argillic													
E2801	141	S09TX071-2161	50													
E2802	1M	S09TX071-2153	0-15													
E2803	26	S09TX071-3082	0-10													
E2804	134	S09TX071-3082	10-28													
E2805	135	S09TX071-3082	28-82													
E2806	132	S09TX071-2165	15-30													
E2807	133	S09TX071-2165	30-50													
E2808	145	S09TX071-3100	0-5													
E2809	146	S09TX071-3100	5-15													
E2810	147	S09TX071-3100	15-30													
E2811	148	S09TX071-3100	30-50													

							KCl									
LAB	pH	-------NH4OAc EXTR BASES-------					EXTR	NaOAc		BASE			CAL-	DOLO-	CACO3	GYP
NO	(H2O)	CA	MG	NA	K	TOTAL	AL	CEC	ECEC	SAT	ESP	SAR	CITE	MITE	EQ	SUM
	1:1	----------------Meq/100g----------------								----%----			----------%----------			
E2798												11				
E2799												15				
E2800												11				
E2801												11				
E2802												12				
E2803												18				
E2804												10				
E2805												9				
E2806												8				
E2807												9				
E2808												19				
E2809												19				
E2810												18				
E2811												19				

	SATURATED PASTE EXTRACT									BULK DENSITY			WATER CONTENT			
LAB	ELEC	H2O								0.33	OVEN		0.33	15		
NO	COND	CONT	CA	MG	NA	K	HCO3	CL	S04	BAR	DRY	COLE	BAR	BAR		
	dS/m	%	----------------Meq/l----------------							----g/cc----		cm/cm	----WT%----			
E2798	12.4	29	34.9	24.7	61.7	0.3										
E2799	5.4	31	8.0	4.9	37.4	0.2										
E2800	8.9	30	24.0	13.2	48.3	0.1										
E2801	7.8	34	19.5	11.5	44.3	0.1										
E2802	7.4	35	16.0	10.7	42.2	0.3										
E2803	12.6	45	21.5	22.2	82.6	1.0										
E2804	6.4	43	14.5	11.5	36.1	0.1										
E2805	5.1	43	10.5	9.0	28.7	0.1										
E2806	6.6	48	18.5	13.2	32.2	0.1										
E2807	5.1	47	11.0	9.0	28.7	0.1										
E2808	16.5	49	25.5	37.8	108.7	2.0										
E2809	9.3	36	10.5	14.0	67.4	0.9										
E2810	10.6	32	13.0	18.1	71.3	0.2										
E2811	8.3		8.0	11.5	59.6	0.1										

Appendix D: December 2009

SOIL CHARACTERIZATION LABORATORY

SOIL AND CROP SCIENCES DEPT., THE TEXAS AGRICULTURAL EXPERIMENT STATION

SOIL SERIES: PEDON NUMBER: 01/29/10

SOIL FAMILY: pg 1

LOCATION: NRCS water soluble extracts (12/09)

		PARTICLE SIZE DISTRIBUTION (mm)												
		----SAND----						---SILT---		---CLAY---				
		VC	C	M	F	VF	TOTAL	FINE	TOTAL	FINE	TOTAL		COARSE	
LAB		(2.0-	(1.0-	(0.5-	(0.25-	(0.10-	(2.0-	(0.02-	(0.05-			TEXTURE	FRAG-	ORGN
NO	ID	1.0)	0.5)	0.25)	0.10)	0.05)	0.05)	0.002)	0.002)	(<0.0002)	(<0.002)	CLASS	MENTS	C
		----%									-----		%	%
E2833	S09TX071-2351-1													
E2834	S09TX071-2351-2													
E2835	S09TX071-2351-3													
E2836	S09TX071-2353-1													
E2837	S09TX071-2353-2													
E2838	S09TX071-2352-1													
E2839	S09TX071-2352-2													
E2840	S09TX071-2352-3													
E2841	S09TX361-2354-1													
E2842	S09TX361-2354-2													
E2843	S09TX361-2354-3													
E2844	S09TX361-2355-1													
E2845	S09TX361-2355-2													
E2846	S09TX071-2357-1													
E2847	S09TX071-2357-2													

							KCl									
LAB	pH	----NH4OAc EXTR BASES----					EXTR	NaOAc		BASE			CAL-	DOLO-	CACO3	GYP
NO	(H2O)	CA	MG	NA	K	TOTAL	AL	CEC	ECEC	SAT	ESP	SAR	CITE	MITE	EQ	SUM
	1:1	----Meq/100g----								---%---			---%---			
E2833												5				
E2834												7				
E2835												6				
E2836												16				
E2837												14				
E2838												7				
E2839												14				
E2840												8				
E2841												6				
E2842												8				
E2843												7				
E2844												14				
E2845												13				
E2846												4				
E2847												4				

	SATURATED PASTE EXTRACT									BULK DENSITY			WATER CONTENT	
LAB	ELEC	H2O								0.33	OVEN		0.33	15
NO	COND	CONT	CA	MG	NA	K	HCO3	CL	S04	BAR	DRY	COLE	BAR	BAR
	dS/m	%	----Meq/l----							---g/cc---		cm/cm	---WT%---	
E2833	0.4		0.5	0.2	2.8	0.0								
E2834	0.9		1.0	0.6	6.0	0.0								
E2835	1.5		2.6	1.6	8.6	0.0								
E2836	12.3		22.5	21.4	74.8	0.6								
E2837	9.6		18.5	14.8	57.0	0.4								
E2838	0.7		0.7	0.5	5.0	0.1								
E2839	3.3		3.8	2.5	23.9	0.0								
E2840	4.9		13.5	8.2	25.2	0.0								
E2841	0.6		0.5	0.5	4.1	0.2								
E2842	1.0		0.9	0.6	7.0	0.0								
E2843	1.2		1.4	1.1	7.4	0.1								
E2844	3.6		2.6	4.1	25.7	0.3								
E2845	4.1		3.7	5.8	28.7	0.3								
E2846	0.6		1.1	0.5	3.6	0.1								
E2847	1.3		3.4	1.2	6.4	0.0								

Appendix D: December 2009 (continued)

SOIL CHARACTERIZATION LABORATORY

SOIL AND CROP SCIENCES DEPT., THE TEXAS AGRICULTURAL EXPERIMENT STATION

SOIL SERIES: PEDON NUMBER: 01/29/10

SOIL FAMILY: pg 2

LOCATION: NRCS water soluble extracts (12/09)

		PARTICLE SIZE DISTRIBUTION (mm)												
		---SAND---						---SILT---		---CLAY---				
		VC	C	M	F	VF	TOTAL	FINE	TOTAL	FINE	TOTAL		COARSE	
LAB		(2.0-	(1.0-	(0.5-	(0.25-	(0.10-	(2.0-	(0.02-	(0.05-			TEXTURE	FRAG-	ORGN
NO	ID	1.0)	0.5)	0.25)	0.10)	0.05)	0.05)	0.002)	0.002)	(<0.0002)	(<0.002)	CLASS	MENTS	C
		---%---											%	%
E2848	S09TX071-2356-1													
E2849	S09TX071-2356-2													
E2850	S09TX245-2373-1													
E2851	S09TX245-2373-2													
E2852	S09TX245-2362-1													
E2853	S09TX245-2362-2													
E2854	S09TX245-2361-1													
E2855	S09TX245-2361-2													
E2856	S09TX245-2365													
E2857	S09TX245-2366													
E2858	S09TX245-2364-1													
E2859	S09TX245-2364-2													
E2860	S09TX245-2363-1													
E2861	S09TX245-2363-2													
E2862	S09TX071-2359-1													

							KCl									
LAB	pH	---NH4OAc EXTR BASES---					EXTR	NaOAc		BASE			CAL-	DOLO-	CACO3	GYP
NO	(H2O)	CA	MG	NA	K	TOTAL	AL	CEC	ECEC	SAT	ESP	SAR	CITE	MITE	EQ	SUM
	1:1	---Meq/100g---								---%---			---%---			
E2848												5				
E2849												7				
E2850												8				
E2851												8				
E2852												4				
E2853												5				
E2854												14				
E2855												15				
E2856												3				
E2857												10				
E2858												4				
E2859												3				
E2860												5				
E2861												8				
E2862												7				

	SATURATED PASTE EXTRACT									BULK DENSITY			WATER CONTENT	
LAB	ELEC	H2O								0.33	OVEN		0.33	15
NO	COND	CONT	CA	MG	NA	K	HCO3	CL	S04	BAR	DRY	COLE	BAR	BAR
	dS/m	%	---Meq/l---							---g/cc---		cm/cm	---WT%---	
E2848	0.5		0.5	0.3	3.3	0.1								
E2849	1.0		1.2	0.5	6.4	0.0								
E2850	1.5	64	1.5	1.4	9.6	0.3								
E2851	1.0	33	0.8	0.6	6.9	0.2								
E2852	0.5	60	1.0	0.5	3.5	0.2								
E2853	0.5	60	0.7	0.3	3.5	0.1								
E2854	4.8	60	7.0	5.8	34.3	0.4								
E2855	6.8	24	11.5	6.6	46.1	0.3								
E2856	0.5	42	1.1	0.5	2.8	0.2								
E2857	1.4	45	1.3	0.8	10.0	0.2								
E2858	0.5	54	0.9	0.7	3.2	0.6								
E2859	0.3	42	0.5	0.6	2.3	0.3								
E2860	0.9	59	1.0	1.2	5.0	0.3								
E2861	1.4	64	1.3	1.2	9.1	0.1								
E2862	0.9	70	1.2	0.7	6.3	0.1								

Appendix D: December 2009 (continued)

SOIL CHARACTERIZATION LABORATORY

SOIL AND CROP SCIENCES DEPT., THE TEXAS AGRICULTURAL EXPERIMENT STATION

SOIL SERIES: PEDON NUMBER: 01/29/10

SOIL FAMILY: pg 3

LOCATION: NRCS water soluble extracts (12/09)

		PARTICLE SIZE DISTRIBUTION (mm)												
		---SAND---						---SILT---		---CLAY---				
		VC	C	M	F	VF	TOTAL	FINE	TOTAL	FINE	TOTAL		COARSE	
LAB		(2.0-	(1.0-	(0.5-	(0.25-	(0.10-	(2.0-	(0.02-	(0.05-			TEXTURE	FRAG-	ORGN
NO	ID	1.0)	0.5)	0.25)	0.10)	0.05)	0.05)	0.002)	0.002)	(<0.0002)	(<0.002)	CLASS	MENTS	C
		---%---											%	%
E2863	S09TX071-2359-2													
E2864	S09TX071-2358-1													
E2865	S09TX071-2358-2													
E2866	S09TX071-2360-1													
E2867	S09TX071-2360-2													
E2868	S09TX245-2368-1													
E2869	S09TX245-2368-2													
E2870	S09TX071-2369-1													
E2871	S09TX071-2369-2													
E2872	S09TX071-2370-1													
E2873	S09TX071-2370-2													
E2874	S09TX245-2367-1													
E2875	S09TX245-2367-2													
E2876	S09TX071-2372-1													
E2877	S09TX071-2372-2													

							KCl									
LAB	pH	---NH4OAc EXTR BASES---					EXTR	NaOAc		BASE			CAL-	DOLO-	CACO3	GYP
NO	(H2O)	CA	MG	NA	K	TOTAL	AL	CEC	ECEC	SAT	ESP	SAR	CITE	MITE	EQ	SUM
	1:1	---Meq/100g---								---%---			---%---			
E2863												9				
E2864												5				
E2865												6				
E2866												22				
E2867												26				
E2868												13				
E2869												17				
E2870												0				
E2871												1				
E2872												3				
E2873												3				
E2874												4				
E2875												4				
E2876												4				
E2877												6				

	SATURATED PASTE EXTRACT									BULK DENSITY			WATER CONTENT	
LAB	ELEC	H2O								0.33	OVEN		0.33	15
NO	COND	CONT	CA	MG	NA	K	HCO3	CL	S04	BAR	DRY	COLE	BAR	BAR
	dS/m	%	---Meq/l---							---g/cc---		cm/cm	---WT%---	
E2863	1.2	52	1.2	0.7	8.4	0.1								
E2864	0.4	76	0.5	0.4	3.0	0.2								
E2865	0.5	71	0.5	0.4	3.9	0.1								
E2866	9.6	48	6.0	14.0	69.6	1.1								
E2867	15.2	50	12.0	25.5	113.0	1.0								
E2868	1.8	122	1.3	0.9	13.5	0.1								
E2869	3.5	152	0.5	3.4	23.5	0.1								
E2870	0.4	89	2.4	1.1	0.3	0.2								
E2871	0.1	104	0.7	0.3	0.4	0.0								
E2872	0.6	85	2.3	0.5	3.3	0.1								
E2873	1.2	81	4.4	0.6	5.0	0.0								
E2874	0.6	161	1.2	0.6	3.9	0.1								
E2875	0.7	95	1.2	0.7	4.1	0.0								
E2876	0.3	90	0.3	0.2	2.0	0.1								
E2877	0.6	150	0.8	0.3	4.6	0.0								

Appendix D: December 2009 (continued)

SOIL CHARACTERIZATION LABORATORY

SOIL AND CROP SCIENCES DEPT., THE TEXAS AGRICULTURAL EXPERIMENT STATION

SOIL SERIES:		PEDON NUMBER:	01/29/10
SOIL FAMILY:			pg 4
LOCATION:	NRCS water soluble extracts (12/09)		

		PARTICLE SIZE DISTRIBUTION (mm)												
		----SAND----						----SILT----		----CLAY----				
		VC	C	M	F	VF	TOTAL	FINE	TOTAL	FINE	TOTAL		COARSE	
LAB		(2.0-	(1.0-	(0.5-	(0.25-	(0.10-	(2.0-	(0.02-	(0.05-			TEXTURE	FRAG-	ORGN
NO	ID	1.0)	0.5)	0.25)	0.10)	0.05)	0.05)	0.002)	0.002)	(<0.0002)	(<0.002)	CLASS	MENTS	C
		----% ----											%	%
E2878	S09TX071-2371-1													
E2879	S09TX071-2371-2													

							KCl									
LAB	pH	----NH4OAc EXTR BASES----					EXTR	NaOAc		BASE			CAL-	DOLO-	CACO3	GYP
NO	(H2O)	CA	MG	NA	K	TOTAL	AL	CEC	ECEC	SAT	ESP	SAR	CITE	MITE	EQ	SUM
	1:1	----Meq/100g----								----%----			----%----			
E2878												3				
E2879												4				

	SATURATED PASTE EXTRACT									BULK DENSITY			WATER CONTENT	
LAB	ELEC	H2O								0.33	OVEN		0.33	15
NO	COND	CONT	CA	MG	NA	K	HCO3	CL	S04	BAR	DRY	COLE	BAR	BAR
	dS/m	%	----Meq/l----							----g/cc----		cm/cm	----WT%----	
E2878	0.2	117	0.3	0.2	1.5	0.0								
E2879	0.4	100	0.6	0.2	2.4	0.0								

Appendix D: October 2010

SOIL CHARACTERIZATION LABORATORY
SOIL AND CROP SCIENCES DEPT., THE TEXAS AGRICULTURAL EXPERIMENT STATION

SOIL SERIES: PEDON NUMBER: 10/28/2010
SOIL FAMILY: Pg 1
LOCATION: NRCS water soluble extracts (rec'd 10/15/2010)

				PARTICLE SIZE DISTRIBUTION (mm)												
				---SAND---						---SILT---		---CLAY---				
				VC	C	M	F	VF	TOTAL	FINE	TOTAL	FINE	TOTAL		COARSE	
LAB				(2.0-	(1.0-	(0.5-	(0.25-	(0.10-	(2.0-	(0.02-	(0.05-			TEXTURE	FRAG-	ORGN
NO		ID		1.0)	0.5)	0.25)	0.10)	0.05)	0.05)	0.002)	0.002)	(<0.0002)	(<0.002)	CLASS	MENTS	C
				---%---											%	%
E3616	1	S10TX361-2910		0-5												
E3617	2	S10TX361-2910		5-15												
E3618	3	S10TX361-2910		upper argillic												
E3619	4	S10TX361-2910		50												
E3620	5	S10TX245-2911		0-5												
E3621	6	S10TX245-2911		5-15												
E3622	7	S10TX245-2911		upper argillic												
E3623	8	S10TX245-2911		50												
E3624	9	S10TX361-2912		0-5												
E3625	10	S10TX361-2912		5-15												
E3626	11	S10TX361-2912		30												
E3627	12	S10TX361-2912		50												
E3628	13	S10TX245-2913		0-5												
E3629	14	S10TX245-2913		5-15												
E3630	15	S10TX245-2913		30												

							KCl									
LAB	pH	---NH4OAc EXTR BASES---					EXTR	NaOAc		BASE			CAL-	DOLO-	CACO3	GYP
NO	(H2O)	CA	MG	NA	K	TOTAL	AL	CEC	ECEC	SAT	ESP	SAR	CITE	MITE	EQ	SUM
	1:1	---Meq/100g---								---%---			---%---			
E3616												5				
E3617												5				
E3618												6				
E3619												7				
E3620												6				
E3621												5				
E3622												4				
E3623												4				
E3624												8				
E3625												8				
E3626												12				
E3627												14				
E3628												5				
E3629												6				
E3630												3				

	SATURATED PASTE EXTRACT									BULK DENSITY			WATER CONTENT	
LAB	ELEC	H2O								0.33	OVEN		0.33	15
NO	COND	CONT	CA	MG	NA	K	HCO3	CL	S04	BAR	DRY	COLE	BAR	BAR
	dS/m	%	---Meq/l---							---g/cc---		cm/cm	---WT%---	
E3616	0.8	63	0.7	1.1	4.4	0.1								
E3617	0.5	53	0.4	0.5	3.5	0.1								
E3618	0.7	49	0.5	0.7	4.3	0.0								
E3619	0.9	53	0.5	1.0	5.6	0.1								
E3620	2.5	54	6.0	3.0	13.0	0.1								
E3621	1.7	50	4.7	1.5	8.1	0.0								
E3622	1.2	58	3.2	1.1	5.8	0.1								
E3623	1.0	57	2.5	0.8	5.0	0.0								
E3624	0.7	43	0.5	0.3	5.1	0.1								
E3625	2.4	52	3.6	3.5	15.7	0.1								
E3626	3.3	59	2.8	4.1	22.2	0.1								
E3627	2.9	65	1.6	3.1	21.3	0.0								
E3628	0.7	65	0.8	0.5	4.3	0.0								
E3629	1.2	73	1.8	0.8	7.0	0.0								
E3630	1.6	53	6.0	2.1	5.9	0.0								

Appendix D: October 2010 (continued)

SOIL CHARACTERIZATION LABORATORY

SOIL AND CROP SCIENCES DEPT., THE TEXAS AGRICULTURAL EXPERIMENT STATION

SOIL SERIES: PEDON NUMBER: 10/28/2010

SOIL FAMILY: Pg 2

LOCATION: NRCS water soluble extracts (rec'd 10/15/2010)

				PARTICLE SIZE DISTRIBUTION (mm)												
				SAND						SILT		CLAY				
				VC	C	M	F	VF	TOTAL	FINE	TOTAL	FINE	TOTAL		COARSE	
LAB				(2.0-	(1.0-	(0.5-	(0.25-	(0.10-	(2.0-	(0.02-	(0.05-			TEXTURE	FRAG-	ORGN
NO		ID		1.0)	0.5)	0.25)	0.10)	0.05)	0.05)	0.002)	0.002)	(<0.0002)	(<0.002)	CLASS	MENTS	C
				%											%	%
E3631	16	S10TX245-2913		50												
E3632	17	S10TX071-3090		0-5												
E3633	18	S10TX071-3090		5-15												
E3634	19	S10TX071-3090		15-30												
E3635	20	S10TX071-3090		30-50												
E3636	21	S10TX071-3091		0-5												
E3637	22	S10TX071-3091		5-15												
E3638	23	S10TX071-3091		15-30												
E3639	24	S10TX071-3091		30-50												
E3640	25	S10TX071-3092		0-5												
E3641	26	S10TX071-3092		5-15												
E3642	27	S10TX071-3092		15-30												
E3643	28	S10TX071-3092		30-50												

							KCl									
LAB	pH	NH4OAc EXTR BASES					EXTR	NaOAc		BASE			CAL-	DOLO-	CACO3	GYP
NO	(H2O)	CA	MG	NA	K	TOTAL	AL	CEC	ECEC	SAT	ESP	SAR	CITE	MITE	EQ	SUM
	1:1	Meq/100g								%			%			
E3631												2				
E3632												9				
E3633												9				
E3634												11				
E3635												10				
E3636												6				
E3637												9				
E3638												9				
E3639												6				
E3640												3				
E3641												5				
E3642												5				
E3643												4				

	SATURATED PASTE EXTRACT									BULK DENSITY			WATER CONTENT			
LAB	ELEC	H2O								0.33	OVEN		0.33	15		
NO	COND	CONT	CA	MG	NA	K	HCO3	CL	S04	BAR	DRY	COLE	BAR	BAR		
	dS/m	%	Meq/l							g/cc		cm/cm	WT%			
E3631	1.6	61	8.5	2.0	3.9	0.0										
E3632	2.0	58	2.2	2.1	13.5	0.2										
E3633	1.6	64	1.5	1.4	10.4	0.1										
E3634	3.8	61	5.0	4.9	24.3	0.1										
E3635	4.1	60	6.0	5.8	25.2	0.1										
E3636	0.8	53	0.8	0.7	5.5	0.1										
E3637	0.8	36	0.5	0.3	5.7	0.0										
E3638	1.4	54	1.2	1.1	9.6	0.1										
E3639	1.8	61	2.6	2.3	9.6	0.1										
E3640	0.3	55	0.5	0.4	1.7	0.2										
E3641	0.3	43	0.2	0.1	2.1	0.0										
E3642	0.3	37	0.2	0.1	2.0	0.0										
E3643	0.4	25	0.4	0.3	2.6	0.1										

VITA

Name: Ryan Matthew Mueller

Address: Department of Soil and Crop Sciences, Texas A&M University, 2474 TAMU, College Station, Texas 77843-2474

Email Address: ryanmueller85@gmail.com

Education: B.S., Rangeland Ecology and Management, Texas A&M University, 2007
M.S., Soil Science, Texas A&M University, 2012